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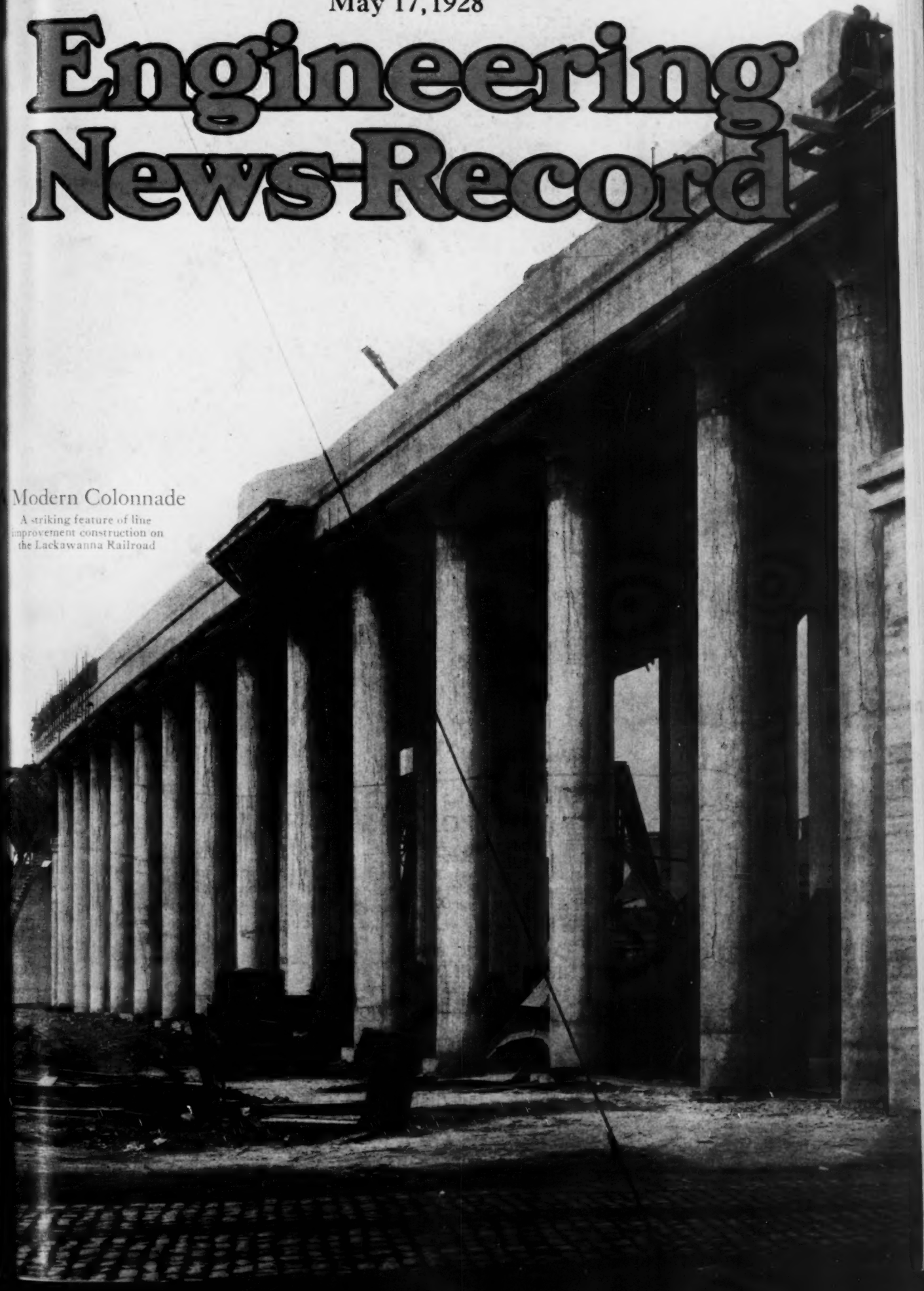
MAY 1 9 1928

May 17, 1928

Engineering News-Record



Modern Colonnade

A striking feature of line improvement construction on the Lackawanna Railroad

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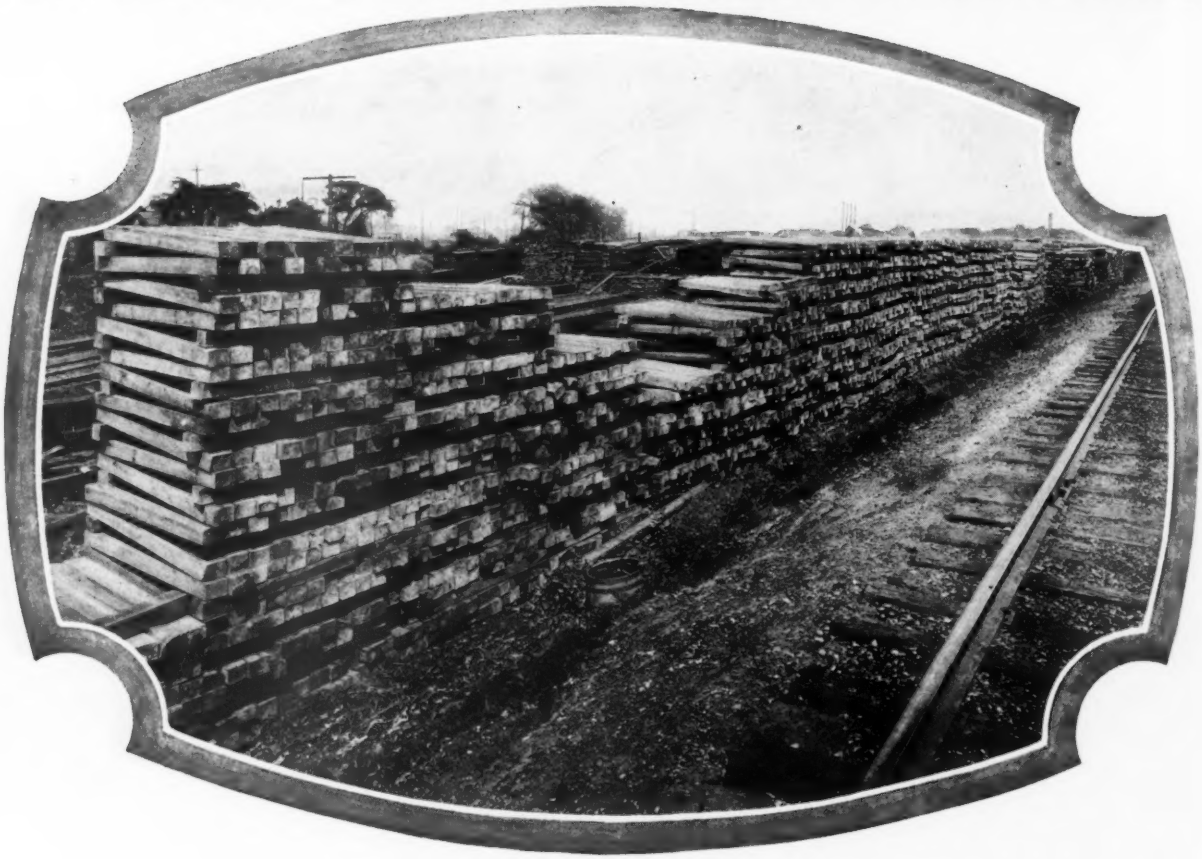

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ENGINEERING NEWS-RECORD

DEVOTED TO CIVIL ENGINEERING AND CONTRACTING

McGraw-Hill Publishing Co., Inc.
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WILLARD CHEVALIER
General Manager
F. E. SCHMITT
Managing Editor

Volume 100 NEW YORK, MAY 17, 1928 Number 20

Efficiency and Economy

PROBABLY more than ony other material, wood since time immemorial has suffered from the haphazard nature of its production and use. Because of the inherently variable quality of timber in Nature and the superadded variations of manufacture, the random factors have always been so large as to restrict not only the efficiency of application but also the degree of economy with which we utilize that rapidly diminishing natural bounty, the forest. Heretofore it has seemed quite impossible to work toward improvement; the industries concerned are so vast and widely scattered that no single-handed effort was able to achieve results. Even the thorough technical work of the Forest Products Laboratory and the well-guided efforts in the parallel commercial field by the National Lumber Manufacturers Association have not gone far along the road to better utilization. But now results appear to be within reach. A comprehensive gathering of producing and using interests by the Department of Commerce in the National Committee on Wood Utilization is progressively consolidating the minds of all concerned and building up the conviction that the entire field must stand together in solving the problems of wood. Measured in physical terms, the work of the committee to date is not impressive. But it has been preparing the ground most effectively. The committee's meeting a week ago brought clearly to light how the unrelated and apparently antagonistic interests in the field are coming to appreciate their common responsibility and the necessity for directed joint effort in working toward higher efficiency and economy. On the present outlook results of lasting value are in prospect.

Another Welded Building

THE SUCCESSFUL completion of a large factory building for the General Electric Company in Philadelphia adds another project to a growing list of welded structures. Each of such structures now in existence has contributed in its turn to our knowledge of the art of welding structural steel. In this respect the Philadelphia building is no exception. Its use of welded trusses is unprecedented. Their manufacture in a modern fabricating shop was a pioneer undertaking. The safety of a working stress of 3,000 lb. per linear inch of weld, although known before, was further assured on this project by an authoritative series of tests. In contrast with the practice on some previous welded structures, only enough fillet bead was run to resist the computed stresses, and all joints were so designed that only shearing stresses were critical. Welding has opened a new field for the designer's imagination in joint design and in the utilization of structural sections. Each new project points out new possibilities in this direction; on this building the truss joints and the crane runway details were the prominent examples. A significant factor surrounding the Philadelphia building also was its design and erection under a city building code. The city building department had to make no unusual concessions in order to issue its regular permit, yet its official recognition of welding augurs well for similar structures planned for other large cities.

Expensive Regularity

THREE million dollars is being spent by the Delaware, Lackawanna & Western Railroad Company at its Hackensack River crossing chiefly to insure a more regular movement of its commuting trains to and from New York City. The money is going into the construction of a new high-level crossing over the navigable channel of that stream. The project is somewhat similar to the larger and more expensive one of the Central Railroad of New Jersey across the same channel at the lower end of Newark Bay, except that in the case of the Jersey Central's crossing the new bridge replaced an old timber trestle, whereas the Lackawanna's new bridge, which is described in this issue, replaces a low-level bridge of steel and concrete which is still good for many years of service. With the present bridge it is necessary to open the draw for practically every vessel of any size which moves up or down the channel. With the new bridge 75 per cent of the traffic on the river will pass without having to raise the draw. Except for a small saving in coal due to a reduction in the number of stops, the new bridge is by no means a revenue-producing investment. Its primary purpose is to insure the regularity of commuting service. Pleas made to the War Department to stop river traffic for an hour or so morning and evening were of no avail, river navigation being the favorite child of that department. Consequently the railroad adopted the only alternative, that of raising the level of its bridge. Had the case been judged on broad economic grounds, there is little doubt that the railroad would have been permitted to postpone making the expenditure for many years to come.

Bus and Truck Control

JOINT state control over motor bus traffic where the bus routes cross state lines has been recommended to Congress by the Interstate Commerce Commission. For this purpose the commission recommends setting up what may be termed joint utility commissions by neighbor states for the purpose of regulating the bus companies whose routes extend into both states. So long as it seems desirable to exercise control over the methods of operating and over the rates and financing of bus operations within the limits of any state, then it is equally important that similar control be exercised over interstate operations. By this proposal to set up local interstate commissions the objections of long-range federal control are avoided. The commission does not recommend either federal or local interstate control over motor-truck companies, yet once

the machinery for the local interstate control of bus traffic is got into working condition it should not be found an insurmountable task to set up a workable system of truck traffic control within the same organization. To argue that exercise of control over truck traffic at this early stage of its development will unduly throttle a new industry is to forget the experience this country gained in the early days of unregulated railroads.

A.G.C. Advance

AN IMPROVEMENT in diplomatic relations with allied interests in construction should follow action taken at the spring board meeting last week in Washington, D. C., of the Associated General Contractors. Specifically, surety bonding practice, lien law standardization, subcontract relations and practices and credit policies were brought sensibly closer to common agreement than many who have watched previous efforts toward an understanding had expected possible. The striking fact in this accomplishment is that the advance made followed quiet negotiation over the conference table and not debate on the floor of the convention hall. That the debates of past years' meetings of contractors have been errors may not be assumed; often they were needed to clarify the situation and to bring sentiment to a head. But these debates have certainly not promoted amicable relations. The movement toward a policy of negotiation and toward diplomatic consideration of opposing views of industrial relations between financing agencies, venders and producers of materials and equipment and the contractor for engineering construction appears to have established its justification in the accomplishments of the meeting at Washington last week. The task of negotiation has just been begun. None should assume that anything more than a beginning has been made. Credits and contractual relations in construction have many ramifications and complexities. There are a multitude of opposing human and business interests. All these cannot in a moment be reconciled and adjusted. But with a disposition to negotiate differences and a sensible set-up of the machinery for negotiation the task is on the way to accomplishment.

The Industry Responsible

IT IS a first requirement in choosing construction methods that they must not create undue hazards. The spectacular 24-story fall of an erection derrick into a crowded New York street chronicled in our news columns last week brings this truth to mind very directly. Similar accidents have in recent years become alarmingly common, and in nearly every instance the accident has involved a serious menace to public safety. To use unsafe working methods is flagrant disregard of the public obligations of the profession, we hold. Yet hoisting construction material over streets crowded with vehicles and people has become the all but universal rule in city building work. Occasionally derricks will fall, guys or hoist ropes will fail and loads will slip out of slings, regardless of precautions; and this being so, it is plain that streets cannot be used as hoistways and public thoroughfares at the same time without serious and constant danger. One simple remedy is to clear the street during actual hoisting operations. Another is to require all hoisting and heavy hauling to be done at night, as some cities do require. Again, hoisting may be confined to the area of the building itself, an expedient readily feasible in most cases and probably in no case impossible. But it is for the industry concerned to work out the method by which safety and efficiency may be combined and to bring them into practice. As yet the building industry has given little, if any, attention to this responsibility. The time is ripe for action; it is best that safe methods be adopted before a sensational disaster forces the matter into the public's hands and results in restrictions imposed by outside authority.

Entering New Pathways

CAREFUL observers of human affairs during recent years could not fail to be struck by the thought that our business and industrial development has been moving toward a crisis. The changing state of production and distribution, their relation to the welfare of the individual and to government, have made old adjustments steadily more unsuited to the needs of the time. That the problems of business have multiplied enormously is shown, for example, by the crowding of legislative calendars of the times with matters of private business. During the same period self-government of business made an uncertain beginning. Now, however, comes a promise that this self-government will progress on large scale and sound basis. The promise was contained in the meeting last week of the United States Chamber of Commerce at Washington, which indicated very clearly that business is entering new pathways.

Two impressive features of the gathering invite special comment: The spirit expressed notably in Judge Edwin B. Parker's opening address, calling for self-purification of business; and the closer relationship between the Chamber and the trade associations. In these features there lies the concrete expression of remarkable future possibilities, and at the same time they make the movement significant to the engineer and the lay citizen alike.

Judge Parker's address, with his demand that the lawless elements, the piratical parasites of industry, be driven out, is the natural and gratifying response to recent events. It gives hope that such unrefreshing developments as the oil scandals will not be repeated and that business will recognize not only the open prohibitions of law and morality but also their constructive implications; that it will not be satisfied to be merely non-criminal. His words point out the trend of the future.

To some extent this change of business attitude has been going on for some time, so that it needs only to be accelerated. Man's many inventions make human intercourse more complex and create ever greater problems, but they also lead to quicker and wider diffusion of knowledge. The growth of news as a factor of daily life has tended to make all affairs more transparent; and when men and their doings stand out in open view, they must live acceptably if they are to endure without penalty, for unobtrusively the community enforces its standards of conduct. These new conditions, affecting business as much as private life, have begun to transform and in time are bound to wholly reconstruct our systems of production and commerce.

Regulation of business under modern democracies is still young, but already, because of the demands just suggested, it has had to be supplemented by group self-regulation in many fields. This voluntary change of method is an obvious expression of the influence exerted by the pressure of community standards, which if not met would in time visit the penalty of loss on an entire group, as it did years ago upon the railroads.

The readjustments of the post-war period gave new strength to the modern tool of industrial self-government, the trade association. But only a few months ago did the Chamber of Commerce take the step that ties it intimately to the trade organizations. The response, as shown by the large attendence of trade association executives, was enthusiastic, and the Chamber can now count on this agency as another effective means of bringing its influence to bear on business and on other forces—such as legislation—which affect business. And this, the second point of great significance in the meeting, opens also a perspective on the vast field of work that lies before the national body. The problems of production will claim a new and larger place in its program through the new intimacy with the trade associations.

In these days when production and distribution are agglomerating into larger and ever larger units, when they are geared into finance and sociology, problems of a scope and intricacy never before known are arising. Up to now they have been worked out singly, in narrow board-rooms. Can they continue so? It may well be doubted. Rather, the outlook is that in time they must be transferred to a wider forum. An age in which a single corporation with its hundred thousand employees outmatches a score of Athenian republics and over night can affect the whole nation's economic health is no longer a time for isolation of industry. Nor is it a time when any man, great or small, can remain indifferent to industry and its questions.

Further, the Chamber's attack in the past has been largely on problems as they have arisen and after they have become acute. Now the suggestion is made that the Chamber by a study of trends help smooth the path of business and improve its service to the public by anticipating developments—a program worthy of a great organization.

If, then, the meeting of last week gives true indication that the Chamber of Commerce is preparing to take up the larger tasks ahead, it is a subject for general gratification. The tasks are most formidable. They far surpass mere ledger reasoning and demand instead the co-operation of the wisest and ablest minds in the land. It is the Chamber's opportunity to bring these minds to bear on its work.

Earth Dam Safety

LAST week we had to record an unprecedented event, the just averted failure of a high earth dam in South Carolina. The accident is of unusual importance not only because it is the first instance of serious trouble with a rolled-earth dam of great height but also because of the peculiar nature of the occurrence. As we write, there is every expectation that the reservoir will drain off harmlessly, but favorable outcome does not diminish the seriousness of the questions involved. Communities which must live in the shadow of high dams are not likely to be satisfied with anything less than full assurance of safety, and it is the profession's obligation to give them that assurance.

On the inherent safety of earth dams the Greenville case contributes no new information. A long and convincing record of safety has been established by past service, more particularly as to dams of great height. Where duly safeguarded against overtopping by floods—which brought disaster in the historic Johnstown instance, among others—the great earth ridges built by human hands have proved to be as stable as Nature's hills. The Greenville experience does not contradict the record, but, if anything, strengthens it by the noteworthy display of stability of the bank after extensive washout and slumping of the downstream face.

Coming to the specific technical aspect of the case, its characteristic is the presence of two separate features: a deeply cut washout over the drain pipe, and a great earth slide considerably to one side of this washout. The slide obviously does not form part of the direct caving along the washed-out gorge, as evidenced by the steep earth slopes surrounding the hole over the pipe when contrasted with the flat but lumpy contour of the slide, typical of earth slips occurring on a saturated substratum.

Rolled embankments such as that of the Greenville dam are not ordinarily susceptible to slumping or flow such as has occurred in a number of hydraulic-fill dams—as Necaxa, Calaveras, or the Garza dam described in the present issue. That the Greenville embankment had normal stability is shown by the uninjured slopes, both downstream and upstream. Occurring at one particular point, the slip denotes conditions different from those in other parts of the embankment. Since the period preceding the slide was one in which seepage from springs was seen near the abutment, close to where the slide later developed, the possibility of unsuspected saturation of the lower strata of the embankment is obviously indicated. As far as the effect is concerned, it is immaterial whether these flows came from the natural groundwater in the adjoining hill or were bypassed from the reservoir through a porous seam. This point, however, should find later answer, since it bears on the safeguards necessary to prevent such saturation. The susceptibility of the embankment soil to softening would appear to be a related matter for study.

Under the circumstances of the case it is difficult to believe that the slide and the drain-pipe washout occurred simultaneously by pure coincidence. More likely the slide initiated the drain-pipe break. In any event the weakness of this pipe is an unpleasant surprise. Apparently it was not bedded upon or covered with concrete, and cast-iron pipe in such a situation is notoriously vulnerable. In this particular instance severe forces acted upon the pipe: a tension of 30 or 40 tons due to downstream pressure of the water upon the gate, the external soil loading and the bursting pressure of the water. Exposed to such forces, uncertainly supported and directly surrounded by the earth of the embankment, it is readily conceivable that slight readjustment of the embankment or the initial stage of a slide near by could subject it to an extra strain sufficient to break it. The pipe unquestionably would have been in more secure condition if fully embedded in concrete. Such vital structural features of dams as outlet works and drain conduits claim the fullest measure of protection that can be given.

It is proper to repeat that the toughness displayed by the embankment in resisting the effects of the washout is one of the noteworthy elements of the accident. Especially in view of the fact that the material used at Greenville was not a hardpan mixture such as is available in glaciated regions, the verdict must be that rolled embankment made an excellent showing here. Duly safeguarded in its foundation, outlets and spillway, it is entitled to the fullest trust, even when carried up to great heights. But the Greenville case, by bringing to renewed attention the menace of infiltration and the necessity of meticulous care in the treatment of drains and outlet works, should contribute to the further improvement of earth dam practice.

Large Factory Structure Built by Arc Welding

Fifty Shop-Fabricated Roof Trusses of Special Design Used on an 80,000-Sq.Ft. One- and Two-Story Structure Erected Under Philadelphia Building Code

AN ARC-WELDED factory building covering some 80,000 sq.ft. has recently been completed at the Philadelphia plant of the General Electric Company. During its design, fabrication and erection all work was done for and by electric arc welding. Preliminary studies of fillet weld stresses, courage and imagination in design, and ingenuity and careful planning in shop fabrication and erection, all contributed to its successful completion. The most important of the several features of the building was the use of about 50 specially welded roof trusses. Other features include: (1) design and erection under a city building code; (2) the development of manufacturing methods for the work in the fabrication shop; (3) a saving of 12 to 15 per cent of steel tonnage on the structure, which as built contains 989 tons; (4) the use of a number of novel and efficient welded details; and (5) collection of data on the ability and production of the welding operators.

The main building is 137 ft. wide and 474 ft. long, connected at one end to an existing parallel building by a headhouse or transept bay 77 ft. long and 167 ft. wide. The main building is divided by a center row of columns into two aisles, 59 ft. wide and 78 ft. wide, respectively, spanned by parallel-chord Pratt trusses approximately 7 ft. deep. The narrow aisle is used for a 10-ton bridge-crane runway with 34-ft. headroom from the floor to the lower chord of the trusses. In the other aisle is a reinforced-concrete gallery floor placed 20 ft. above the ground floor and supported on circular concrete columns. The headhouse will also be used as a crane bay with 43-ft. headroom. The trusses in the headhouse span in a direction normal to those in the main crane aisle. In Fig. 1 is shown a plan with typical sections of the structure.

Erected Under Building Code—As far as can be ascertained, this is the first welded building that has been erected in accordance with requirements of a city building department. The Philadelphia building department granted a special permit for this building, the most important provisions of which were: (1) specification of a working stress of 3,000 lb. per linear inch for a $\frac{3}{8}$-in. fillet weld; (2) the requirement that all welding be done by accepted methods; and (3) the requirement that all welding operators be examined and tested in accordance with best standard practice. The city inspectors expressed their confidence in being able to tell good from bad welds by surface inspection.

A working stress of 3,000 lb. per linear inch of bead was found to provide a factor of safety of about 4 by a comprehensive series of tests made by the General Electric Company on plate specimens joined by $\frac{3}{8}$x$\frac{3}{8}$-in. triangular fillet welds. (Since a $\frac{3}{8}$-in. fillet is 0.265 in. deep, 3,000 lb. per linear inch corresponds to a shear of 11,300 lb. per sq.in.) In tension the welds of the

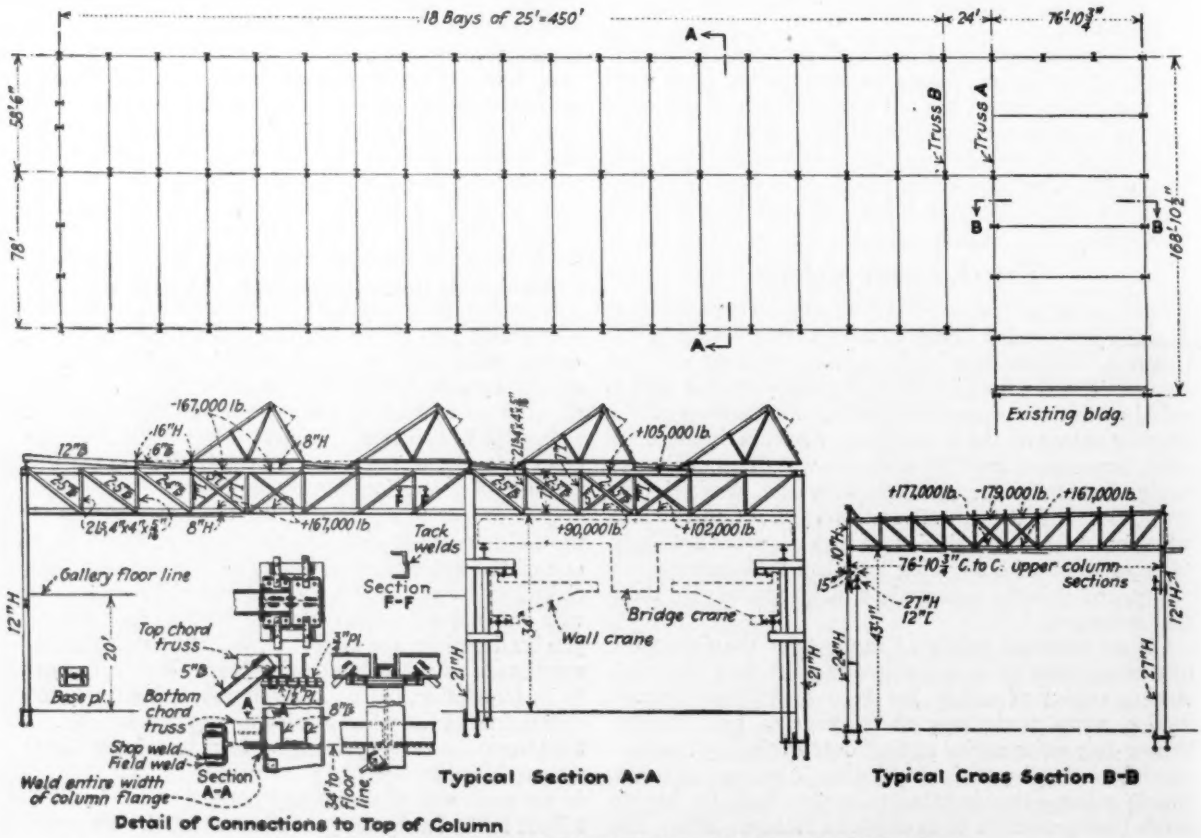


FIG. 1—PLAN AND SECTIONS OF WELDED BUILDING IN PHILADELPHIA

test specimens developed a longitudinal shearing strength of 13,300 lb. per linear inch of the fillet, and in compression a strength of from 15,800 to 17,800 lb. per linear inch. In all cases the specimens were designed to fail in the weld and in 93 out of 96 cases did so fail, on a plane perpendicular to the long side of the triangular fillet. That higher stresses were found for the specimens in compression than for those in tension was attributed to the fact that the compression specimens were short and therefore not subject to the bending that occurred in the longer tension specimens.

Trusses—In the use of welded trusses, the building is outstanding among present welded structures. About 50 Pratt-type trusses are used in the building, spanning the two aisles of the main building and the headhouse, having spans respectively of 58½ ft., 78 ft. and 77 ft. A joint detail of one of the trusses is shown in Fig. 3. The parallel chords are 8-in. wide-flanged beams set with the web horizontal, the verticals are 7-in. I-beams welded between the flanges of the upper and lower chords, and the diagonals are channels welded to the outside of the flanges of the chords. No gusset plates were used.

A roof load of 60 lb. per sq.ft. was used, divided equally between live and dead loads. This was applied both to the level portions of the roof and to the sloping surfaces of the skylight monitors. Unit stresses in steel members were those of the Philadelphia building code.

All connections were simply designed, the areas of welding being made concentric with the center of gravity of the members wherever possible, and all welds were so placed that longitudinal shear stresses were all that had to be considered.

While the trusses in the main building have parallel chords and are uniformly 7 ft. deep, those in the headhouse have sloping end posts and vary in depth from 8 ft. 4 in. at one end to 6 ft. 4 in. at the other in order to carry a sloping roof. Drainage on the main flat roof is provided for by sloping secondary purlins, as shown in Fig. 1.

All trusses were completely shop-fabricated, except one, truss *A*, Fig. 1, at the intersection of the main crane aisle and the headhouse. This truss, Fig. 2 and Fig. 4, was 17½ ft. deep and was therefore shipped to the job in sections and assembled by welding on the ground. It carries the heaviest loads of any truss in the building. These loads include one of 61,000 lb. from the headhouse truss, a crane reaction of 80,000 lb. and a load from the main building roof of 870 lb. per linear foot.

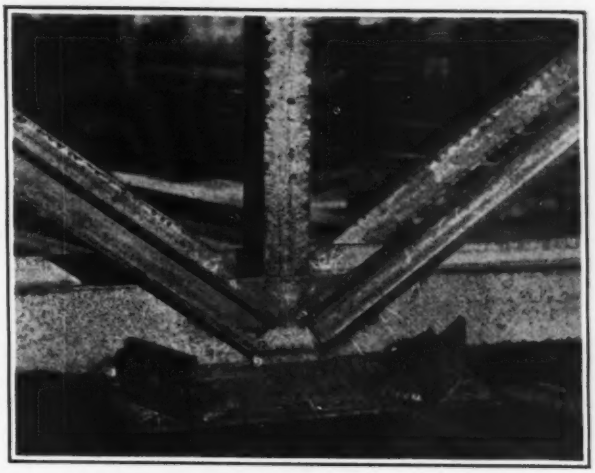


FIG. 3—TRUSS JOINT OF WELDED DESIGN
Chords are H-sections, verticals are I-sections and diagonals are channels. Clip angles anchor sway bracing rods.

Important details of this truss include its method of connection to the headhouse truss and the manner in which it carries the headhouse crane girder. These are shown in Fig. 4. A section of a 10-in. I-beam welded between the two 8-in. channels which form the center vertical provided a support for the headhouse truss. The headhouse crane girder, across the main building aisle, as shown in the left-hand view of Fig. 2, is supported near its third point by two needle beams resting on the bottom chord of truss *A* and extending back to an anchorage on truss *B*. Most of the crane load is taken by the lower chord joint of truss *A*, and the anchorage of the needle beams at truss *B* is largely used to counteract uplift. When truss *A* was fabricated, the two 8-in. I-verticals hung free with a 1-ft. opening between their bottom and the bottom chord of the truss, to permit inserting the needle beams in the field. This was done as shown in Fig. 4. A 9-in. channel welded to the flange of the crane girder and a clip angle welded to the flange of the needle beam furnished the erection connections.

Shop Work—An important part of the work was the development of welding procedure in the fabricating

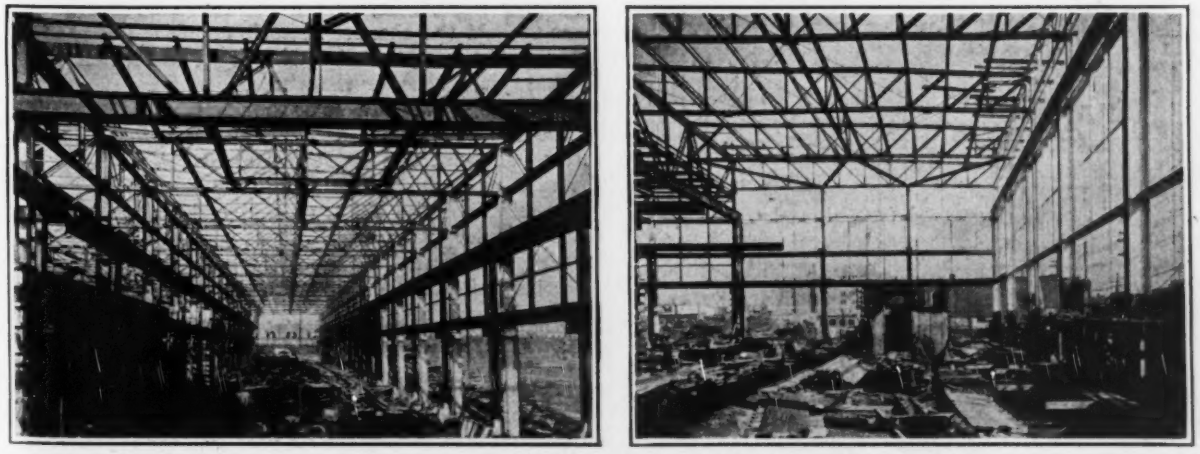


FIG. 2—THE TRUSSED ROOFS OF THE CRANE BAYS
On the left is the crane bay of the main building containing 2-ton wall cranes as well as a 10-ton bridge crane. The view on the right shows the headhouse, which will also carry a 10-ton bridge crane. In both views the heavy truss which spans the intersection between the main building and the headhouse is shown.

shop. For the trusses a series of 18-in. I-beams somewhat more than 20 ft. long were placed about 9 ft. apart on the shop floor to form a work-table grillage. An 8x8-in. angle was welded across the I-beams and the bottom chord of the truss was clamped to it. The top chord was then correctly spaced and clamped directly to the I-beam grillage. Next the verticals and diagonals were clamped in position on the chords and the joints welded while the trusses were lying flat. For the 206 monitor trusses special jigs were used which expedited the work greatly.

As a rule, five welders were necessary, each using a single-operator motor-generator set. An arc voltage from 23 to 25 and amperage of 175 were used with a $\frac{5}{16}$-in. welding electrode. Of the 989 tons of steel in the building, 745 tons passed through the fabricating shop.

As reported in *Engineering News-Record*, Dec. 22, 1927, p. 720, shop tests made on these trusses were unusually successful. A typical truss carrying a total load equivalent to $1\frac{1}{2}$ times the load for which it was designed showed a deflection of only about $\frac{7}{8}$ in. As the loads were removed, the deflection decrements almost exactly equaled the increments recorded under increasing loads. Upon the removal of all applied loads, it was found that no slipping of the joints had taken place during these tests.

Economy—A saving of about 1,200 gusset plates was effected in the building, largely in the roof trusses. Added to this were other savings, notably a very simple column base connection, Fig. 5, making in all a total saving of from 12 to 15 per cent of steel over a comparable riveted structure.

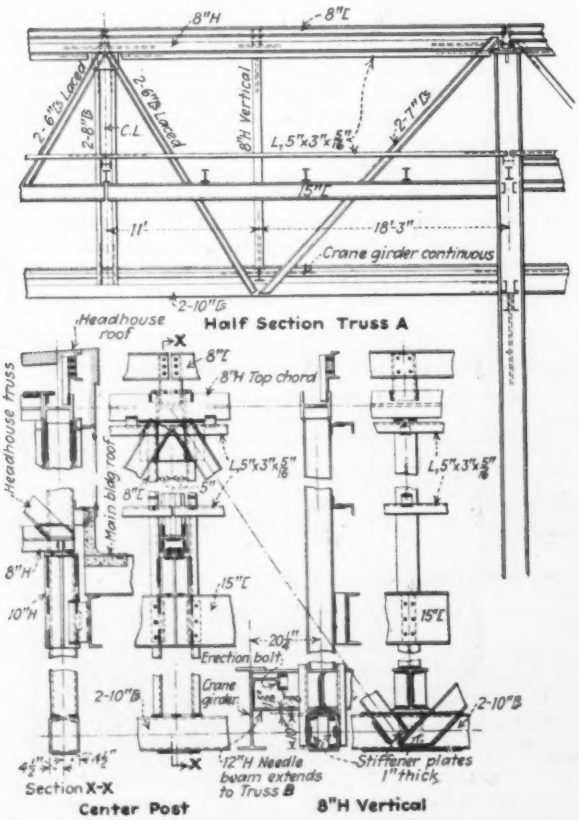


FIG. 4—DETAIL OF TRUSS AT INTERSECTION OF HEADHOUSE AND MAIN BUILDING

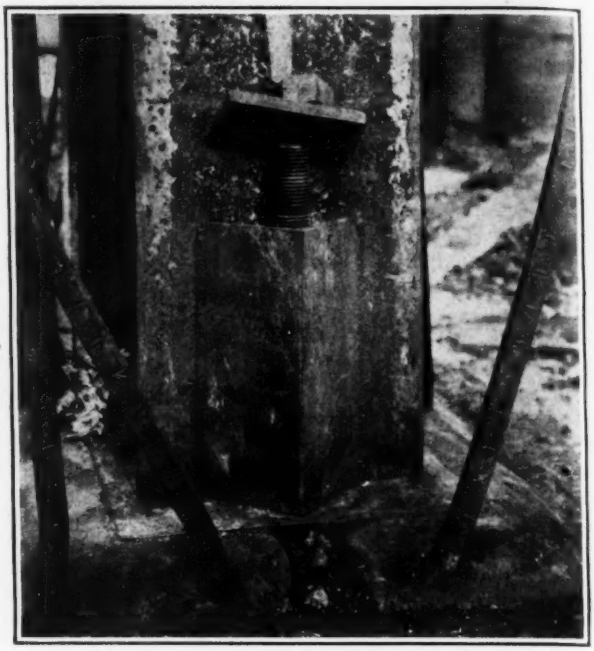


FIG. 5—ECONOMICAL AND EFFICIENT COLUMN BASE CONNECTION

Crane Details—Ten-ton bridge cranes are used both in the main building and in the headhouse. The method of supporting the crane girder in the headhouse is shown in Fig. 1. In Fig. 6 are shown the crane details in the main building, where each post, in addition to carrying the bridge crane girder, also carries a 2-ton wall crane. An auxiliary stub-column was inserted to carry the bridge crane.

The use of welding made possible an efficient and simple detail for the wall-crane supports. These wall cranes exert horizontal reactions at the upper and lower levels and a vertical reaction at the lower level as shown, the horizontal reactions being 32,000 lb. and the vertical reactions 20,000 lb. The wall-crane rails are carried by 10-in. channel cantilevers attached to the main column and to the stub-column. The connection angle was punched for erection bolts and welded to the main column in the shop. Corresponding holes punched in the cantilever channel brackets were provided for erection bolts to hold the channel in position while a bead was being run between the connection angle and the channel. A seat plate beneath the channel brackets was also welded between the flanges of the main post in the shop.

The use of welding permitted a rapid and efficient method of connection between the new construction and the existing building. Final construction contemplates the removal of the old truss and end columns in the existing building and a transfer of roof load to the new trusses. To effect this, the new longitudinal wall trusses were carried past their intersection with the last new headhouse truss and welded to the old building column. The new transverse truss was then erected, framing into this longitudinal wall truss a short distance from its connection to the old building column. New purlins were then carried over the new truss and welded to the old purlins, transferring the old roof load to the new construction. The old columns and the old truss were then removed by burning with an acetylene torch.

Performance of Welding Operators—During the work

on the building numerous tests and examinations were made of the welding operators. Shop tests indicated that there was little variation between specimens made by an individual welder, although there was a variation of about 22 per cent between the poorest and the best specimens of any particular welder. In all cases the lowest values were used.

All lengths of welds specified on the drawings were marked on the assembled steel, and a comparison was made of the specified lengths of fillet welds with the actual measured lengths of welds on the trusses. On one truss there was found to be a total length of actual welding of 633¼ in., compared with 598 in. as specified. The maximum excess of actual over specified for any one weld was about 46 per cent. The maximum deficit of actual as compared with specified for any one weld was about 8 per cent. Few individual fillets were less than 10 per cent shorter than specified. These results were interpreted as meaning that careful inspection was necessary, but that they in themselves were not sufficient to appreciably reduce the factor of safety.

It is believed that truss work costs can be reduced by the use of jigs for rapid assembly and by specifying on the drawings actual rather than imaginary working points.

The shop fabrication and field erection required about two months each. The building, at first designed as a

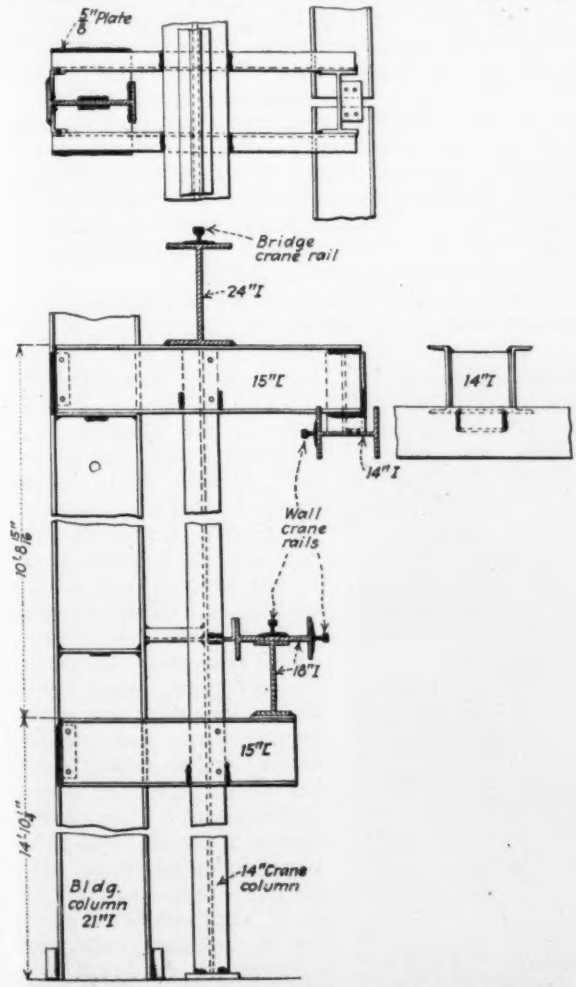


FIG. 6—WELDED CRANE GIRDER DETAILS IN THE MAIN BUILDING

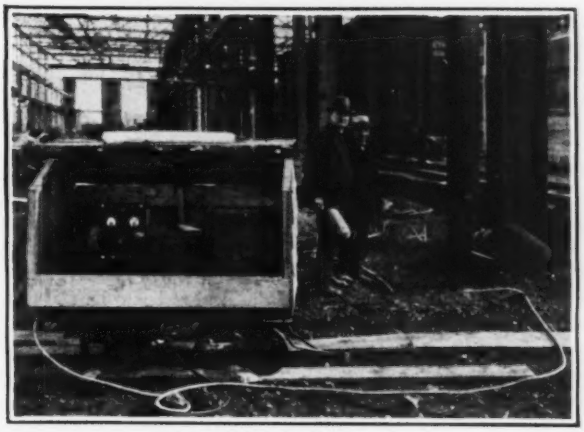


FIG. 7—THE WELDING EQUIPMENT

riveted structure, was later redesigned for welding by the American Bridge Company under the supervision of the General Electric Company. J. H. Edwards, chief engineer of the American Bridge Company, was in charge of the design, fabrication and erection. For the General Electric Company, Frank P. McKibben acted as consulting engineer, co-operating with William Dalton, of the company's plant engineering department. Harris & Richards, Philadelphia, were the architects, and the U.G.I. Contracting Company, Philadelphia, was general contractor.

Unique Sewage-Works and Sewer Outfall

Pre-chlorination and post-chlorination Imhoff tank treatment, with both grease and gas collection, and sale of the final effluent for irrigation at an estimated yearly income of $10,000 to $15,000 make up the unique sewage-works put under construction in February for San Bernardino, Calif. The works are designed to serve a population of 60,000 and to operate entirely without odors or other nuisance that would be objectionable in a residential district. Grease will be skimmed from the settling compartments of the tanks and gas will be collected by means of submerged covers built over the gas vents and utilized for auxiliary electric power generation. A radial flow mechanical clarifier for secondary sedimentation will be used and an overhead monorail system carrying 25-cu.ft. baskets will be installed for removing sludge. The San Bernardino sewage is now being used in its raw state for irrigation purposes on a sewage farm 4 miles south of the city. The new works include a 6,800-ft. outfall from the plant to the point where the effluent will be delivered to irrigationists. This outfall will consist of three inverted siphons of 15-, 18- and 24-in. diameters, respectively, automatically controlled by Venturi meters and electrically operated gate valves at the lower ends so that any one of them, either separately or in combination with others, can be used to maintain at all times a cleansing velocity. One 300-lb. chlorinator will be installed in the upper end of the siphons, to be controlled from the plant by remote control, and another 300-lb. chlorinator for regular use in pre-chlorination will be installed in the control house, together with 200-lb. duplicate chlorinators for final chlorination. Provision is made for storage and handling of chlorine in ton containers. The designs have been prepared by the Currie Engineering Company and C. E. Johnson, of San Bernardino, Calif.

Automatic Underground Railway Handles London's Mail

Tunnel With Double-Track Narrow-Gage Line Connects Post Offices—Trains Controlled From Stations

AN AUTOMATICALLY controlled mail-handling underground railway 6½ miles long, connecting seven important post offices and two railway terminals, has been put into service in London, England. Its special purpose is to expedite the mail service in the business districts by superseding a large proportion of the mail trucks now operated on the streets, thus not only giving more rapid movement but reducing delays due to traffic congestion and incidentally reducing the congestion of street traffic to some extent. According to information given in *The Engineer* and the *Railway Gazette*, of London, about 750 tons of mail matter is handled daily in transfer, and the railway will provide for 800 trips per day at an average speed of 20 m.p.h., as compared with 5 to 7 m.p.h. for the motor trucks.

A single iron-lined tunnel 9 ft. in diameter carries a double-track line of 2-ft. gage. At the stations, most of which have island platforms, the tunnel diameter is 21 ft. 3 in., or 25 ft. where a third track is required. From the ends of the stations each track is in a short stretch of 7-ft. tunnel, converging into the main 9-ft. tunnel. Loops for terminal movements, as required at some stations, have radii of 60 to 80 ft. As several extensions are planned, stub or blind tunnels were driven for the future junctions, so that construction work on the headings can be started without interfering with operation of the present line. For the loops and junctions the tunnel diameter is 10 to 16 ft. to provide the necessary clearance.

Track construction consists of 33-lb. T-rails on oak ties embedded in the concrete floor. Between the track rails is the conductor rail, with its top 3 in. above them.

FIG. 1—AUTOMATIC MAIL TRAIN AT A PLATFORM

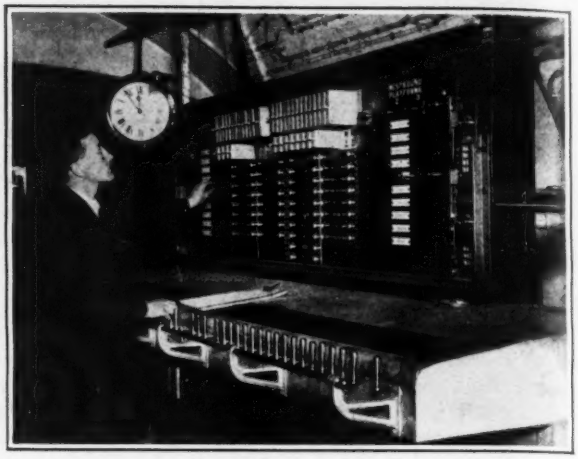


FIG. 2—BOARD FOR CONTROL OF TRAIN MOVEMENTS

All stations are at summits of grades, to assist in starting and checking the trains. The third-rail current is 440 volts, except that block sections adjacent to stations may have either 440- or 150-volt current, the latter being to check trains which are to stop at the station.

Four-wheel steel box cars or covered cars for carrying the mails are 13 ft. 5 in. long, 2 ft. 10 in. wide and 5 ft. high above the rails. Each is a motor car, with a 22-hp. motor on each axle, and has a load capacity of about 1,100 lb. They are operated singly or in trains of two or three cars. Their maximum speed is 35 m.p.h. and the trains can be operated on a two-minute headway. Mail sacks and packages are carried in light steel bins or containers, on small wheels, so that there is little handling of individual sacks or packages in loading and unloading the cars. Storage-battery locomotives are provided for track maintenance work and for hauling trains that may break down between stations.

Elevator shafts, 12 and 14 ft. in diameter, spiral gravity chutes and inclined conveyors connect the station platforms with the basements of the post offices and main line railway stations. Beneath the platform is a longitudinal belt conveyor, so that inbound mail can be dropped from the bottom of the containers through traps onto the belt, and thus be delivered automatically to the elevator or inclined conveyor.

Train movements are controlled from cabins on the station platforms. Each line is divided into block sections between stations, and each section is "live" as soon as a train has passed into the second section ahead. Thus there is always a "dead" section between following trains. The platform sections of track are made "dead" or "live" by the station operator, who can energize the third rail with 440-volt current for starting a train or with 150 volts for

checking an incoming train that is to stop at the platform. An illuminated diagram in the control cabin at each station shows the position and destination of each train. The station operator then sets power-operated switches for the proper route of the approaching train and also energizes the proper sections of the conductor rails, so that the train will either stop at the platform or continue its journey. Switch movements are interlocked with current distribution. This system is in general similar to that of switch and signal interlocking, except that the current is used for motor purposes on the third rail instead of for operating signals.

The contractors for the tunnel were John Mowlem & Company. H. C. Gunton is principal power engineer for

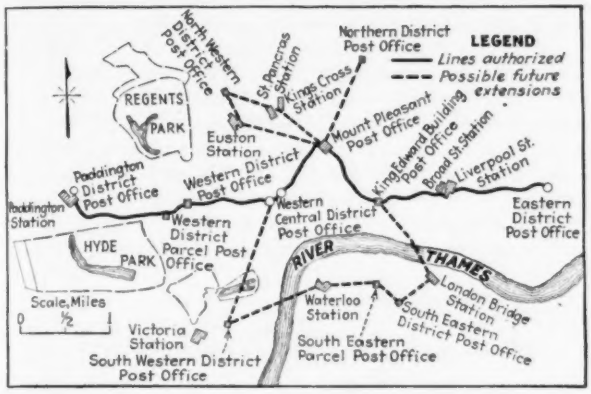


FIG. 3—MAP OF POST OFFICE TUBE RAILWAY

the Post Office Department, with Evan Evans as manager of the railway and W. G. Carter engineer of maintenance. H. H. Dalrymple-Hay was consulting engineer for the construction, and A. M. Sillar consulting electrical engineer.

Reservoir Covered to Prevent Algæ Growth

To prevent algæ growth a small water-works reservoir at Edwardsville, Ill., was covered recently by a plank and tar-paper roof supported on a steel frame. The supply, which is furnished by the Edwardsville Water Company, is pumped from wells to a concrete reservoir 70 ft. square at the top, 40 ft. square at the bottom, 10 ft. deep, having a capacity of 0.25 m.g. Before the reservoir was covered, algæ growth made cleaning necessary twice a month. Treatment with copper sulphate, suggested by the State Department of Health, did not completely prevent nuisance from tastes and odors. The water in the reservoir was subject to contamination from dust, dirt, insects and animal pollution, and by workmen during the frequent cleanings. In addition, the cleaning operation reduced the storage and increased the fire hazard. Cleaning was made possible without cutting off the entire supply by a partition in the reservoir. Suggestions that the reservoir be covered were made repeatedly by the engineering division of the State Department of Health, but were not heeded until the works changed ownership in May, 1927. After that the reservoir was covered at an expense of only $1,500. The foregoing information is taken from an article in *Illinois Health News*, by C. W. Klassen, assistant engineer, and H. F. Ferguson, chief engineer, Illinois State Department of Health, who state that the covering of the reservoir will save about $62 a year.

Interstate Bus Regulation Recommended

INTERSTATE bus regulation is receiving much attention in Washington at the present time. The House committee on interstate commerce is considering the Parker bill, drawn up for this purpose; and the Interstate Commerce Commission has recently sent recommendations to Congress in favor of legislation to the same effect.

The House committee has already held public hearings, at which the testimony of 22 witnesses representing bus owners and manufacturers, steam and electric railways and various interested associations gave their opinions and recommendations. All the witnesses, with one exception, recognized the necessity for regulation, but the provisions of the bill itself did not meet with universal approval.

The recommendations of the Interstate Commerce Commission are the result of a special investigation by Commissioner Leo J. Flynn, during the course of which hearings covering every phase of bus and truck transport were held in thirteen cities in various parts of the United States. The final recommendations of the commission follow closely those of Mr. Flynn, and are also in accord with the provisions of the Parker bill.

The system proposed calls for the regulation of interstate buses by the individual states, acting in conjunction with one another through joint boards upon which the Interstate Commerce Commission would be represented. In cases where any state did not exercise its power, action would devolve upon the Interstate Commerce Commission. Under the new system railroads would be authorized to operate bus lines, subject to the same requirements as the regular bus companies. Joint rates between railroads and bus lines would be permitted, rates would be subject to regulation and bus transportation by passes would be prohibited, as it now is to the railroads. A certificate of public convenience and necessity would be required before new lines could be put into operation. The recommendations are limited almost entirely to the transportation of persons. The commission does not feel that the transportation of property (trucking) requires regulation at the present time, excepting when done by carriers which are already under the control of the commission.

Although the recommendations of the Interstate Commerce Commission agree generally with the provisions of the Parker bill, considerable outside opposition has developed to the machinery provided by the bill for putting them into effect. The delegation of federal power to the states is a new political principle which does not meet with universal approval. The representative of the National Automobile Chamber of Commerce, C. C. McChord, testified at the Parker bill hearing that, in his opinion, the machinery provided by the bill would be hopelessly complicated and might prove to be unconstitutional.

The committee on interstate commerce of the House of Representatives has the Parker bill under consideration, and is expected to report it, with modifications, in the near future. Whether any legislative action will take place this session remains to be seen, for the short time remaining before Congress adjourns makes consideration of the bill problematical, in view of the many other matters on the House calendar.

Slumps Complicate Garza Dam Construction

Material in Banks, Largely Clay Balls Formed in Pipe Line, Flattened Out and Required Change of Slopes From One on Three to One on Ten or Fifteen

By J. C. Nagle and T. C. Shuler
Chief Engineer and Resident Engineer, Respectively,
Garza Dam, Dallas Water-Works, Dallas, Tex.

THE Garza dam for the Dallas, Tex., water-works is an earth embankment bisected by a concrete spillway section. The main dam has a crest length of about 11,000 ft., of which the concrete spillway and abutments constitute about 550 ft. There are also twin outlet conduits of concrete, 14½x19½ ft., which penetrate the embankment approximately in the line of the original stream. A general description of these main structures was published in *Engineering News-Record*, April 16, 1925, p. 630. As originally designed the dam had a volume of about 2,000,000 cu.yd. During construction serious slides developed in a part of the embankment, and these required a change in cross-section which added to the volume of fill.

Hydraulic Fill Adopted—The valley floor across which the dam extends consists of clay overlying alternating layers of sand and gravel over sandstone or shale. These were suitable materials for hydraulic fill and the work was planned for this method. The drawings of Fig. 1 show the plan, sections and a profile of the dam. The standard section called for a width of core at any level equal to the height of dam above this level. The other dimensions are given on the drawing.

Installing Plant—The first operation was to drill four wells and put up storage tanks for a water supply for camp use and for concrete. A camp was built large enough to house about 270 workmen. To ship in materials and machinery 2¼ miles of standard-gage track was built, as shown by Fig. 1. Closely following the completion of the railroad, the construction of the dredge hull was begun. This occupied about 70 days, during which time the base of the dam was cleared and grubbed,

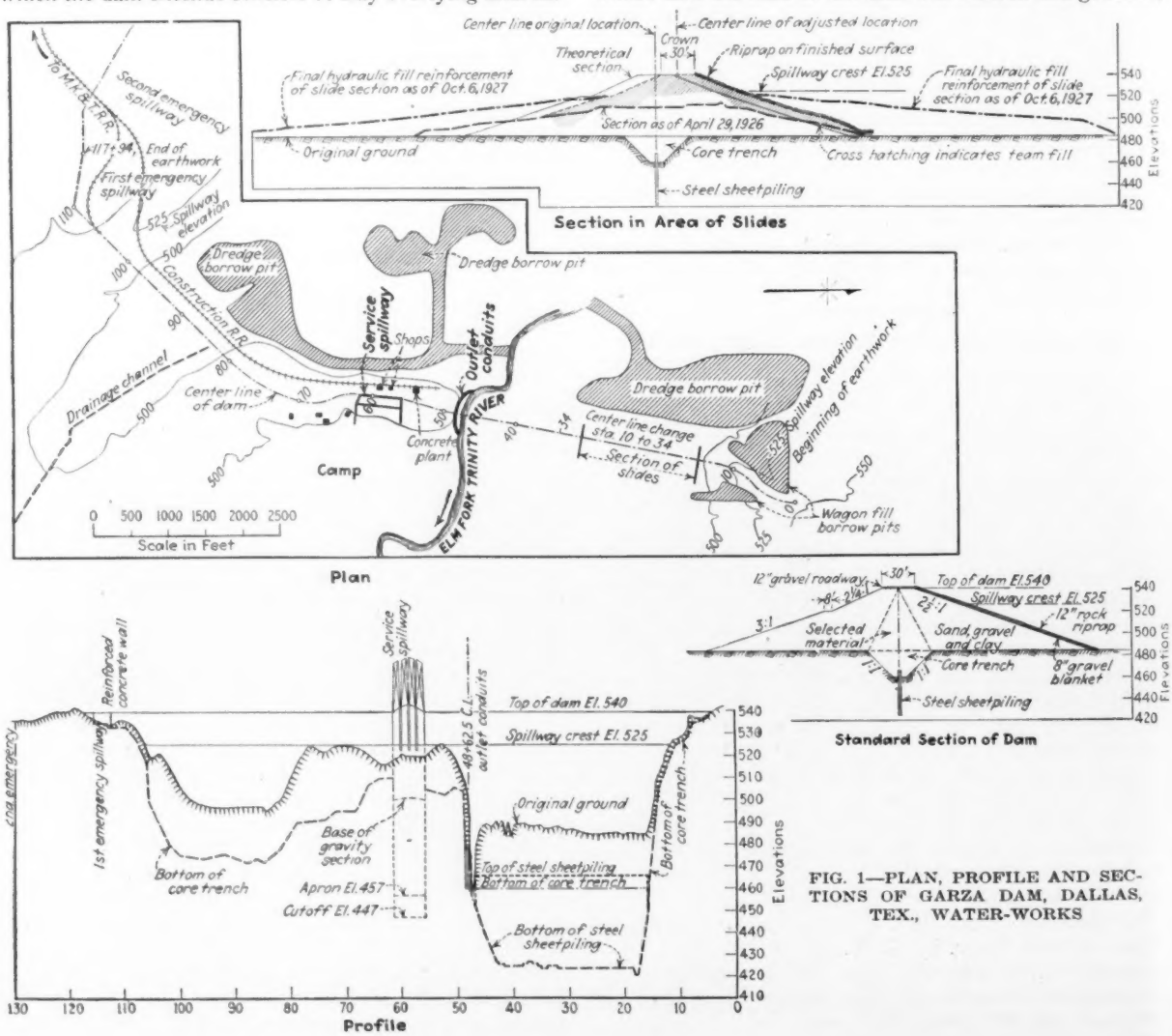


FIG. 1—PLAN, PROFILE AND SECTIONS OF GARZA DAM, DALLAS, TEX., WATER-WORKS

FIG. 2—ARRANGEMENT FOR DRIVING STEEL SHEETING IN CORE TRENCH

Machine constructs working platform by moving I-beams ahead as driver pulls forward. View shows beam being shifted.

the core trench excavated, and the sheet piling driven. (Fig. 2.)

The dredge, Fig. 3, had a timber hull 112x40 ft. and 111 ft. deep, stiffened by two longitudinal steel trusses on which were set the pump base and the motor. The dredging unit consisted of a 24-in. pump driven by a 1,600-hp. direct-connected electric motor, run at a speed of 360 r.p.m. Power was brought to the dredge by twin submarine cables, 1,800 ft. long, which were floated on cedar rafts. The long cable made possible a wide working range from the power line.

The capacity of the dredge was possibly 10,000 cu.yd. a day under conditions of wide fill and good material, but these conditions were rarely obtainable. The maximum monthly output was 167,000 cu.yd. and was obtained while using a 20-in. discharge and when pumping material which broke down readily. The average monthly output, previous to encountering slides, was 110,000 cu.yd.

Construction Sequence—There was about 1,900,000 cu.yd. of material to be pumped, so it was necessary to prepare for at least one flood season. Therefore a 1,500-ft. section at the north end was left open for passing flood water and for final closure. The fill proper was started between this section and the river as soon as the core trench and sheet piling had been completed. (Fig. 2.)

The general plan was: (1) Bring the 1,800-ft. section immediately north of the river up to a point within 30 ft. of grade; (2) complete the section south of the river; (3) complete the 1,800-ft. section to full height, and (4) make the final closure in the 1,500-ft. section at the north end.

Hydraulic Fill, North of River—The conduit excavation was carried on while the dredge was under construction, and the material was placed in two 15-ft. dikes along the toes of the earth fill north of the river. The dredge started operation between these dikes in January, 1925.

The dredge borrowpit contained clay overlying varying depths of sand and gravel, the bottom being sandstone. The depths of the sand and gravel varied greatly, and the overlying clay constantly changed from sandy clay that would go into solution readily to clay that broke up in chunks and was rolled into large balls as it passed through the pipe lines. This variation of material caused considerable trouble by plugging pipe lines and being extremely hard to control on the fill.

The clay balls, by reason of their size and weight, dropped near the discharge end of the pipe and took a steep slope toward the core, thus enabling the pipe line to be carried several feet higher than the pool level. On the other hand, when material which all went into suspension was being pumped the sand and gravel were deposited near the discharge and took a very flat slope toward the pool. This necessitated extensive use of shore boards and forced the pipe line to be carried down almost to pool level at times.

Probably a fair estimate of the materials in the outer portions of this section would be 20 per cent sand and gravel and 80 per cent clay balls. A 6-in. cast-iron ball test of the core showed, at an elevation 5 ft. below spillway level, a penetration of from 1 to 2 ft. The slopes were carried up in advance of the pumped fill by two ¾-cu.yd. draglines, each having a 35-ft. boom; the average lift of the dikes was about 3 ft.

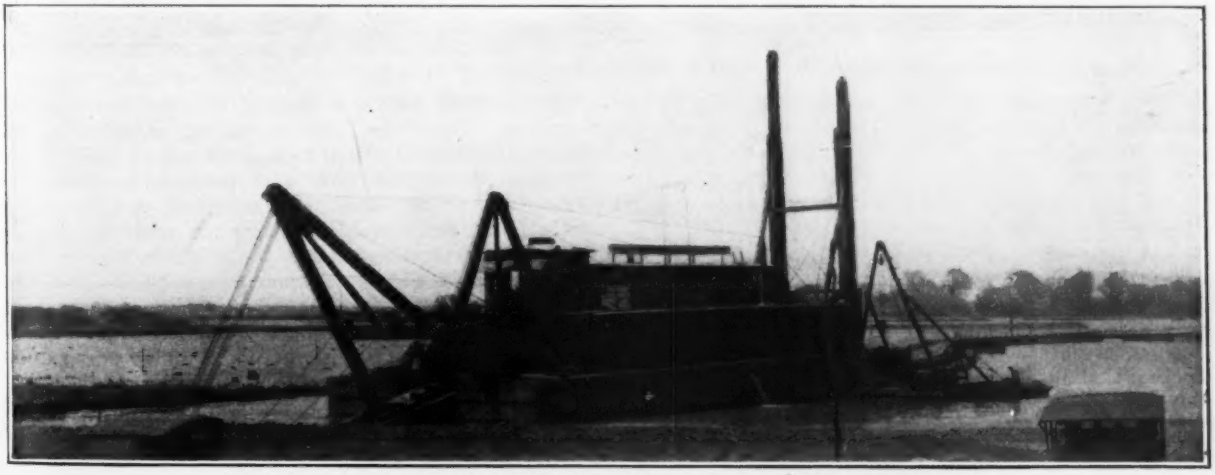


FIG. 3—HYDRAULIC DREDGE PUMPING TO DAM EMBANKMENT

With the north fill up to 30 ft. below crest, as scheduled, work was begun on the south fill, and when this was completed, pumping into the top of the north fill was resumed. A short time previously the discharge line of the dredge had been changed from a 20-in. to a 24-in. pipe.

The character of material for the remainder of the

section was similar to that previously pumped, except that it contained a higher percentage of sand and gravel. There seemed to be a greater tendency toward sand stratification in the core after the change to a 24-in. pipe line, due to the larger quantities of water to be taken care of, both at the discharge and through the core pool.

Hydraulic Fill, South of River—The section of the dam south of the river was started in May, 1925, and was completed in September, 1925. (Fig. 4.) It was about 45 ft. high, with a core trench about 30 ft. deep, which was dug to and toed into shale. The core trench waste was spread equally and uniformly on both sides.

The dredge borrowpit was about 15 ft. deep and was in material practically all of which went into solution. This material was easily pumped, and in the second month's work the maximum monthly yardage was obtained. While in the lower portions of the fill and while the fill was wide there was no trouble in controlling the core, but from the height where the fill narrowed down to about 170 ft. and the core to 25 ft. considerable trouble was experienced in maintaining the proper fineness. To prevent the fine sand from going into the core, the pipe line had to be carried 12 in. or less above the pool level. Even with this slight difference in elevation it was necessary to have a crew of sixteen men on the pipe line, using as many as 100 shore boards.

Trap pipes were installed as a remedy, but were unsuccessful. The coarse sand dropped out through the traps and left only the very fine sand to be discharged at the end of the line, and this could be controlled only with great difficulty. As the core narrowed down and became shallow the velocity of the water going toward the pool spillway increased, and if the pool level were not raised, would tend to take away the finer particles, leaving a thin stratum of fine sand across the core.

With this size dredge the sectional area of the pool had to be large enough to carry about 25 sec-ft. with a slow velocity. It was found that in case of velocities over 1 sec.-ft. the sand stratum usually appeared. The core was tested daily, either by the cast-iron ball or by a pointed pole, and if sand strata were found, they were removed by the draglines.

A number of core samples were taken at different elevations and screened as low as the 200-mesh sieve. The average results were as follows:

Retained on	48 sieve	0.5 per cent
Retained on	100 sieve	19.5 per cent
Retained on	200 sieve	38.0 per cent
Passed	200 sieve	42.0 per cent

Whenever the amount passing the 200-mesh sieve dropped as low as 35 per cent, this material was removed by dragline and refilled with finer material.

Hydraulic Fill, Closure Section and Slides—The closure section at the north end was started in January, 1926, with still another class of material. The adjacent borrowpit was about 17 ft. deep, with a light layer of sand and gravel at the bottom. The overlying clay was tough, and practically all of it was discharged in the form of clay balls from 1 to 6 in. in diameter. The amount of sand pumped on the fill was very small, but owing to the difference in size between it and the clay balls, it was troublesome to keep out of the core. The construction of this section was continued in the usual manner until slides began to develop in January, 1926, when the fill was 15 ft. high. The first development of the slides was a slight subsidence of the shoulders of the fill and a bulging of the toes. Operations were continued, using the same material, to a height of 25 ft., when it became apparent that the theoretical section of the dam could not be maintained with this material and method. The slides were continuing and the fill had assumed slopes of about 1 on 5 instead of 1 on 3.

FIG. 4—CORE POOL ABOUT 12 FT. BELOW CREST, SOUTH SECTION OF FILL

As a remedy, the contractor proposed to move the center line of the dam 20 ft. upstream, and by means of a 70-ft. boom dragline to dig the upstream side to the theoretical slope (1 on 3) down to the original ground, giving this excavation a base of 20 ft. The upstream side was then to receive a blanket of team fill, placed in 12-in. layers and 20 ft. in width, this blanket to be carried up to the top of the present fill and to be continued in the form of levees to the top of the dam. On the downstream side, the wagon fill was to take the form of levees above the present fill.

Team fill was started on July 3, 1926, on the upstream side and was carried out as proposed. It might be said here that while excavating the fill to a 1 on 3 slope some slides were started, showing that even after standing several months the hydraulic fill previously composed of clay balls was not in a stable condition. Large movements on the upstream side began to occur when the blanket reached the height of the dredge fill (El. 511). It became apparent at this time that further protective measures were necessary. The riprap (Fig. 5) on the upstream side was following the wagon fill closely and was high enough to permit a further blanket fill over its top. The dredge then pumped a fill of clay onto the riprap and up to El. 498, or 13 ft. above the

original ground, which gave the desired result for the time being.

Then the dredge pumped a 3-ft. lift between the wagon fill dikes, which caused further movement on both sides. Again a clay ball fill was pumped above the riprap to a height of 22 ft. above the original ground, allowing the fill to take a free slope as pumped.

The dredge continued pumping between the team fill levees and along the toes to stop movements of the fill until April, 1927, when it was decided to concentrate the dredge operation on preventing fill movements by pumping banquettes on both sides of the dam and to complete the fill within the section by teams. The dam was then about 19 ft. below the top. This plan was used to completion, with several large movements of the fill toward the dowstream side and minor movements toward the upstream side.

FIG. 5—ROCK RIPRAP ON DAM SLOPE

The pumped banquette on the upstream side was then 36 ft. above the original ground, whereas that on the downstream side was approximately 33 ft. above the original ground, both slopes ranging from 1 on 10 to 1 on 15.

Transit points were kept on the fill at all times to ascertain movements and their magnitude. Usually, several days before a slide, these points would have small horizontal movements not noticeable to the eye. The larger slides, after the maximum movement had begun, would move possibly 6 ft. per day for one or two days, and then continue with a very slow movement for several days.

Summation on Slides—It is apparent that the material used was unsuitable for a hydraulic fill of 1 on 3 slopes. The clay in its original bank was tough and very impervious, but in pumping it broke down into balls, which in the course of ten or fifteen days were penetrated with enough water to cause them to squeeze together by their own weight and form a solid mass. This mass contained a much higher water content than did the material in its original state even though submerged, but was still so impervious that it would not drain and remained indefinitely a tough semi-plastic mass. In brief, the hydraulic fill composed of clay balls was too soft to maintain ordinary slopes. The successful protective measures used simply flattened the slopes.

The total amount of team fill was approximately 220,000 cu.yd., of which about 170,000 cu.yd. was in the theoretical section of the dam. The remaining 50,000 cu.yd. was placed partly in the upstream blanket and was partly lost in the slides.

Engineering Supervision and Contractors—Subsequent to the submission of Nagle and Thompson's preliminary investigation in January, 1924, J. C. Nagle and R. A. Thompson were retained as engineers in charge of detailed surveys, designs and construction, with O. N. Floyd as principal assistant, T. C. Shuler resident engineer on the work at the dam and K. F. Hoefle in charge of land surveys and all construction work above the dam. J. L. Lockridge had charge of general design. The services of Lockridge, Floyd & Woolverton were terminated in February, 1926, at which time Mr. Thompson, having made certain other engineering connections in California, became consulting engineer, with J. C. Nagle as chief engineer, T. C. Shuler as principal assistant (resident) engineer and T. M. Brown as office engineer. In February, 1927, Mr. Thompson accepted the position of state highway engineer for the State of Texas and shortly afterward resigned as consulting engineer on the Dallas water project. The W. E. Callahan Construction Company of Dallas, Tex., had the general contract, with the Puget Sound Bridge & Dredging Company sub-contractor on hydraulic fill work. Hill, Wilson & Watson did the team work for the Puget Sound Bridge & Dredging Company on the closure section of the main embankment north of the conduits.

Public Water Supplies in Illinois

A tabulation summarizing the conditions of public water supplies in Illinois for the years 1921 and 1928, as prepared by the State Department of Public Health, is given herewith. This department, through H. F. Ferguson, chief sanitary engineer, is conducting routine inspections of public water supplies and gradually bringing about improvements, more particularly in the smaller municipalities. It acts, however, only in an advisory capacity, having no authority to require cities or companies to make the waters safe according to the standards set by the department. The population given is that of the 1920 census:

	1921	1928
Total population of municipalities	5,083,990	5,083,990
Population served by public water supplies	4,696,381	4,956,698
Percentage of total population served	92.5	97.8
Total municipalities having public water supplies	459	505
Quality of supplies: Good	356 (77%)	389 (79%)
Doubtful	67 (15%)	93 (18%)
Bad	36 (8%)	13 (3%)
Persons supplied with "good" water	3,604,122	3,758,671

In the following comparison of 1921 and 1928, the increase in number of supplies classified as "doubtful" is caused by several supplies changing from "bad" to "doubtful" and not entirely carrying out the department's recommendations so as to be classed as "good":

Increase in population served by public water supplies	260,317
Increase in number of municipalities served	46
Increase in number of "good" supplies	42
Increase in number of "doubtful" supplies	26
Decrease in number of "bad" supplies	23
Increase in population served by "good" water	154,549

New Flood Flow Records for California Streams

Six-Day Storm in March Gave Runoff Exceeding 200 Sec.-Ft. Per Square Mile, or More Than Twice Previous Record

By F. E. Bonner
District Engineer, U. S. Forest Service, San Francisco, Calif.

A SIX-DAY storm of great intensity produced new flood flow records from a number of high watersheds of the Tahoe and Eldorado National Forests in the central portion of California's mountain district during the latter part of March, 1928. Coming at the end of a protracted dry period in a year of subnormal rainfall and toward the close of the precipitation season, the storm was as unexpected as its results were disconcerting. Ordinarily in the high altitudes the precipitation of the heavy storms is in the form of snowfall, but in this instance temperatures during the early part of the storm were unusually high and the warm rain carried away much of the winter snow pack, causing the unprecedented floods. Toward the end of the storm the weather turned colder and the rain changed to snow, replacing much of that which had been lost. The total precipitation for the storm ranged from 15 to 20 in. over the higher altitudes.

The accompanying tabulation summarizes the preliminary records thus far obtainable. In three instances unit rates of discharge exceeded 200 sec.-ft. per square mile. Two of these, Deer Creek and Fall Creek, are for relatively small drainage basins and not of great importance. The discharge of 202 sec.-ft. per square mile at Spaulding dam, however, is remarkable. This rate is not large in comparison with flood yields in some other localities, but for a high basin of considerable size in the Sierra Nevada it is beyond all precedent.

The highest rate of runoff observed previously in the 25 years or more of definite record at any Sierra Nevada station above the foothill altitudes was 95 sec.-ft. per square mile, at Downieville, on the North Yuba River, during the flood of May 11, 1915. Moreover, the tributary area at Downieville comprises 71 square miles of territory somewhat lower in altitude than the South Yuba above Spaulding.

In the recent flood the spillway of the Spaulding dam, a combination arch and gravity concrete structure 275 ft. high, became submerged and on March 26 the entire crest length of the dam (about 1,900 ft.) was overtopped 1.3 ft. for eight hours without causing any damage.

At the Bullards Bar dam, on the North Yuba, the flood conditions were also extraordinary, with a record of 117 sec.-ft. per square mile for the large watershed of 486 square miles. This is a constant-angle overflow dam about 170 ft. high. At the flood crest of 57,000 sec.-ft. the depth of water over the dam was 13.8 ft. No apparent damage was done to the dam, but the power plant, immediately below, was flooded and much of the small equipment was damaged.

The flood flow of the American River was estimated to have been larger than any that has occurred since 1862. On the Mokelumne the flood was probably larger than any during the 23-year period of record on that stream. On the Stanislaus conditions were apparently about equivalent to the 1907 peak. Runoff from the watershed tributary to Almanor dam was slightly less than in 1907, but at the Butte Creek dam it was higher.

The peak flow from the upper Sacramento basin was somewhat less than in 1907, and this, combined with the fact that maximum discharges from Feather, Yuba and American rivers failed to combine simultaneously, resulted in an aggregate flow in the lower river channel considerably below the 1907 record, so that the flood-protection system was not taxed to capacity.

On the whole it is reassuring to engineers that flood conditions of such magnitude could be experienced with relatively small amount of damage. Nevertheless it is probable that the new discharge records established for some of the high mountain watersheds will have an important effect on the design of hydraulic structures and transportation facilities in these localities.

PRELIMINARY FLOOD FLOW DATA—STORM OF MARCH, 1928

Stream	Location	Peak Discharge (Sec.-Ft.)	Day of Month	Trib. Area (Sq.Mi.)	Sec.-Ft. Per Sq.Mi.
Pit River	Pit No. 3 dam	16,300	29	4,747	3.4
Butte Creek	Head dam	7,945	26	61	130
Butte Creek	Centerville Head dam	9,950	26	103	97
Feather River	Oroville	130,000 (b)	27	3,020 (b)	43
North Fork Feather	Almanor	8,000 (a)	26	500	16
Butte Creek	Butte Valley dam	2,000 (a)	26	75	27
Bucks Creek	Storrie	2,877 (a)	27	45 (c)	64
Bucks Creek	Bucks dam	2,180 (a)	27	28	78
North Yuba River	Bullards Bar dam	57,000	26	486	117
South Yuba River	Spaulding dam	17,390	26	86 (d)	202
Middle Yuba River	Milton	3,800	26	41.6	91
Canyon Creek	Bowman dam	3,328 (a)	26	24	139
Fall Creek	Div. dam	1,135	26	5	227
Deer Creek	Scotts Flat	4,340	26	20	217
Bear River	Bear River head dam	8,120	26	106	77
Bear River	Van Giesen dam	16,000	26	134.5	119
Truckee River	State line	11,000	25	436 (e)	25
Truckee River	Lake Tahoe	17,000 (a)	25	500	34
American River	Folsom	184,000 (a)	25	1,900	97
Sacramento River	Rio Vista	325,000	28	.....	...
Mokelumne River	Electra Diversion	22,934	25	360	64
Stanislaus	Sand Bar dam	9,250	25	300 (f)	31
Tuolumne	Don Pedro dam	38,000	25	962 (g)	40
Merced	Exchequer dam	18,000 (a)	25	1,060	17

(a) Mean daily flow.
(b) Excludes area tributary to Almanor, Butte Creek and Bucks dams.
(c) Includes area above Bucks dam.
(d) Excludes area tributary to Fordyce and Kidd Lakes which were not spilling.
(e) Excludes area above Lake Tahoe outlet.
(f) Excludes area tributary to Relief reservoir.
(g) Excludes area tributary to Hetch Hetchy and Eleanor reservoirs.
(h) Reliability doubtful; final figures may show considerably higher crest.

PRECIPITATION DATA FOR STORM OF MARCH 22-27, 1928
From U. S. Weather Bureau Records

Station	Elevation Above Sea Level	Drainage Basin	Total for Storm (In.)
Mt. Shasta	3,555	Sacramento	4.05
Redding	590	Sacramento	5.05
Fall River	3,340	Pit River	3.95
Inskip	4,808	Feather	16.53
Downieville	3,150	Yuba	15.86
Nevada City	2,580	Yuba	12.79
Fordyce dam	6,500	Yuba	19.76
Auburn	1,360	American	8.40
Placerville	1,925	American	11.14
Sacramento	71	American	2.28
Tahoe	6,230	Truckee	10.17
Sonora	1,825	Stanislaus	7.85
Lake Eleanor	4,650	Tuolumne	12.20
Yosemite	3,960	Merced	7.77
Huntington L.	7,000	San Joaquin	6.39
Fresno	293	.....	0.80
San Francisco	225	.....	3.29
Los Angeles	293	.....	.86
Mt. Wilson	5,850	.....	1.30
Eureka	64	.....	3.51

Scour Prevention Below Dams

In the captions of an article entitled "Studies on Prevention of Scour Below Overfall Dams" on p. 696 of the May 3 issue of *Engineering News-Record*, the term "hydraulic pump" was used instead of the correct term, "hydraulic jump."

Tests of Wire and Fittings for Cable Highway Guard

Precautions in Dip Test—Preparing Samples for Weight of Coating Test—Wrap Test Proposed—Area Test for Clips

By C. W. Betz
Assistant Engineer, Bureau of Tests, Allegheny County, Pittsburgh, Pa.

With 91 miles of wire rope guard rail constructed since Jan. 1, 1924, and a large amount of highway construction under way and contemplated, the Allegheny County (Pennsylvania) highway department has developed rather careful tests for guard rail cable and fittings. In the 91 miles of barrier constructed, both ¾-in. and 1-in. cable have been used; this cable has required 4,476 miles of wire, all of which has had careful inspection and has been tested at the place of fabrication.

Specifications for Cable—In the specifications the following requirements are listed for the two sizes of galvanized-wire cable used:

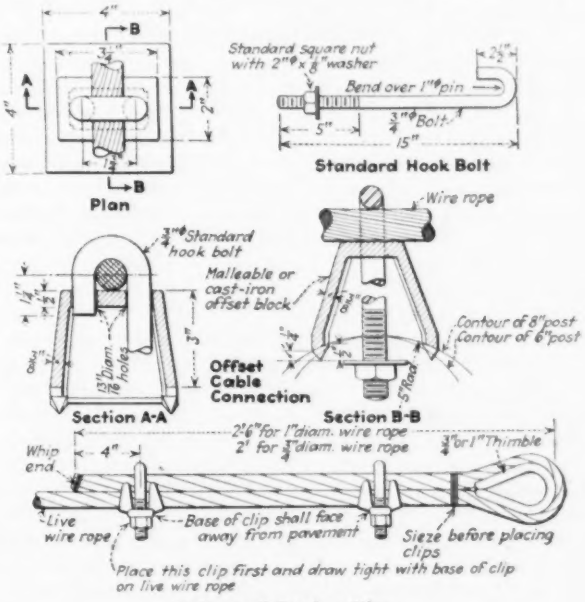
Item	¾-In. Cable	1-In. Cable
Diameter of galvanized wire, in.	0.117—0.124	0.105—0.112
Number of wires in strand	7	7
Lay, wire in strand, max., in.	4.5	4.5
Number of strands in cable	3	7
Lay, strand in cable, max., in.	7.5	10.0
Tensile strength, min., lb.	13,000	30,000
Preece test, on individual wire, minimum dips in min.	3½	3½
Oz. zinc per sq. ft., min., individual wires	0.8	0.8
Nature of coating	Smooth, adherent	Smooth, adherent

The tests required include the Preece test and weight of coating test on individual wires; the diameter limit of the individual wires; the number of wires per strand and the number of strands in the cable; the lay of the wires in the strand and the lay of the strands in the cable; and finally the tensile strength of the finished cable. In addition to this the galvanizing is visually inspected for appearance, smoothness, adhesion, etc. Methods of making these tests have been developed as follows:

Preece or Dip Test—The A.S.T.M. standard method (A 90-24) is employed for this test. While the test cannot be relied upon to determine weight of coating, it is considered a good indication of the uniformity of the coating distribution. This test must, however, not be placed in the hands of an inexperienced operator, as there are many pitfalls. The main one is a false coating of bright copper which not infrequently makes its appearance before the zinc has been displaced and the iron reached.

This copper plate has sometimes all the appearances of the plate obtained on the steel at true failure, and in many cases cannot be rubbed off with towel or waste. It will usually flake off when scraped lightly with a knife. Other false coatings which sometimes appear vary from the bright lustrous copper color down to a reddish brown color. Some wire may be encountered where the first dip noticeably does not take effect on the zinc coating. This is due usually to an almost invisible coating of zinc salt on the wire (assuming, of course, that the wire has been properly cleaned of grease and oil). A momentary dip in a weak hydrochloric acid solution (2 per cent) will remove this coating without affecting the zinc, after which the first dip in the copper sulphate solution will secure the proper results.

Weight of Coating Test—The A.S.T.M. standard method (A 90-24) is employed. This method requires the length of wire used to be measured, and, of course, when separated from the cable it is not straight. Following the bends with a string or a fine wire is slow and unsatisfactory. In the county laboratory, after wires from a piece of cable about 15-in. long have been separated, the irregularities and twists are hammered out on a wooden table using as a hammer a piece of 2x4-in. timber, having a handle carved at one end. Wire can be straightened with a few light blows which will not injure or knock off the coating, unless the adhesion is


Plan
Standard Hook Bolt
Standard square nut with 2"ø x ⅛" washer
Bend over 1"ø pin
¾"ø Bolt
5"
15"
Wire rope
¾"ø Standard hook bolt
Malleable or cast-iron offset block
Contour of 8" post
Contour of 6" post
Offset Cable Connection
Section A-A
Section B-B
2'6" for 1" diam. wire rope
2' for ¾" diam. wire rope
¾" or 1" Thimble
Whip end
4"
Live wire rope
Base of clip shall face away from pavement
Sieze before placing clips
Place this clip first and draw tight with base of clip on live wire rope
Method of Placing Clips

FITTINGS FOR STANDARD CABLE GUARD RAIL, ALLEGHENY COUNTY HIGHWAYS

extremely poor. The proper length of wire to be used (usually a length such that the loss of weight in grams gives directly ounces of zinc per square foot) may then be readily measured and the wire cut off with a wire cutter.

Rather than to weigh the wire straight and use a tall cylinder for dipping, or to coil the wire in one large turn and use an evaporation dish, it has been found very convenient and satisfactory to wrap the wire around a rod of some kind having a diameter of about 1¼ in., thus forming a small spiral spring. The objection has been raised that this might cause peeling and loss of coating, but a good wire will not shed its coating by such wrapping, also the diameter of the "spring" may be increased to take care of this. The "spring" so formed lends itself nicely to weighing on any balance pan, and a beaker of convenient size can be used for dipping.

Wrap or Mandrel Test—The writer is of the firm belief that a wrap or mandrel test, in which wire is wrapped around a mandrel of specified diameter to determine the adhesion of the coating to the steel, should be included in specifications. Galvanized wire is frequently encountered which, while passing the Preece test and weight of coating test, fails to pass even a lenient wrap test. Some wire will crack, peel or powder when wrapped around ten times its own diameter, which the writer would consider to be a lenient wrap test. Other wire may be found, the coating of which will remain intact when the wire is wrapped around its own diameter. This

is, of course, a very severe wrap test. Using a mandrel whose diameter is between five and ten times the diameter of the wire could be considered a fair and practical wrap test, the size mandrel depending upon the size of the wire and the use to which it is to be put.

Another requirement which the writer thinks could be advantageously put in use is a maximum limit to the weight of coating, since it has been found in the experience of the county laboratory that practically without exception extremely high weight of coating and poor wrap tests go hand in hand.

Tests of Cable Fittings—Galvanized cable clips, thimbles, T-bolts, eye-bolts, washers, etc., are all required to pass a 3½-minute Preece test. As yet no weight of coating requirement has been incorporated into the specifications, but the time is not far distant when this will be done. In this connection the problem arises of determining the area of the pieces. The various bolts and washers present no particular difficulty, but it is practically impossible to calculate the area of clips with any degree of accuracy. The oil film method has proved unreliable with this shape of casting. The method in use, which so far as the writer knows is original here, consists of pasting tinfoil, carefully cut and fitted, over all irregular surfaces which cannot be readily calculated. These pieces are cut out of a weighed piece of tinfoil whose weight has been determined to run uniform. All tinfoil remaining out of the original piece, after the clip has been covered, is then weighed. The difference, then, between this weight and the weight of the original piece gives the weight used in covering the clip. When the weight per square inch of the tinfoil is determined, the area of the clip is easily ascertained. While this procedure is tedious and could not be repeated as a routine determination, it has been found that any particular style of clip runs so nearly uniform that a few area determinations suffice to determine for good, with sufficient accuracy, the area of that style of clip.

Desilting Irrigation Canals

All-year irrigation, which came into vogue a few years ago on many irrigation projections, has necessitated new methods in canal maintenance. Where canals cannot be taken out of service without interfering with their function, new ways have to be devised for keeping them free of silt and weeds. In Imperial Valley in California, where the silt deposition is extremely heavy, this has become an important problem. On that project silt removal has always been an expensive item in the 2,500 miles of canals and laterals maintained, and the excavated material usually had to be dumped along the outside of the canal banks, where it would slump down and spread over valuable land. The present practice in Imperial Valley is to allow the canal to change its grade wherever possible so that the resulting increase in velocity will suffice to carry most of the silt through the laterals either to the sluiceways or onto the land. This necessitates considerable expenditure in raising dikes, but it is found to be much less costly, especially on the larger canals, than trying to maintain a flatter grade by dredging. On the large main canals, experience indicates that a grade of 1¼ ft. per mile will enable the canals automatically to keep themselves clear of silt, and this gradient can often be maintained without the excessive cost of maintaining a flatter grade by dredging and at the same time avoids the difficult problem of disposing of the dredged material along the sides of the canals.

Débris Openings Built in Spillway of California Dam

Irrigation District Dam on Débris-Laden Stream Designed to Permit Floods to Carry Gravels Through Structure

A CONCRETE dam completed recently on the Bear River in California to store water for the Camp Far West irrigation district includes provision, about 7 miles east of Wheatland, for a reservoir site with a 3,400 acre-ft. capacity, considered sufficient to serve the district's 3,000 acres of farmland. The drainage area above the dam is 262 square miles, from which the maximum discharge on record is 24,000 sec.-ft. Storage is needed only in the later parts of the irrigation season, as the district has normal flow rights in the river ample for the early part of the season. The dam was designed with a gravity section arched in plan and has a maximum height of 76 ft. The total crest length is 372 ft., of which 150 ft. in the stream channel is designed as an overpour spillway provided with 10-ft. stop logs.

CONSTRUCTION VIEW OF CAMP FAR WEST DAM

The desirability of passing through the structure the sand and gravel brought down by high river stages is due to large deposits of gravel left in the streambed by early placer mining operations. Each successive freshet moves great quantities of this débris downstream, and there was thought to be danger that the reservoir might be filled by these deposits. To prevent this, six 7x12-ft. sluiceways were built in the lower part of the spillway, the upstream end of each sluiceway being provided with a structural-steel sliding gate. The vertical distance from the top of the central sluiceway to the spillway crest is 29 ft. The gates are operated by a hoist car traveling on a track above the wasteway crest. The sluiceway floors have a grade of 2 per cent. They are lined with timber, for convenient renewal in case of erosion.

The reservoir operating method which is to make the sluiceways effective is as follows: At the end of the irrigation season and before the heavy runoff comes, the sluiceway gates will be opened so that the floods with their heavy burden of débris can move directly down the channel. When the spring floods are over, the sluiceway gates are to be closed and storage begun.

The dam was designed by Martin C. Polk, engineer for the Camp Far West irrigation district; J. R. Head was resident engineer for the district. The work was carried out under contract by the Ward Engineering Company, San Francisco, E. C. Panton, general superintendent.

Lackawanna Makes Costly Line Change to Reduce Bridge Delays

New $3,000,000 Hackensack River Crossing Built to Speed Up Suburban Service—Interesting Flat Slab Approaches and Heavy Three-Track Lift Bridge Feature Design

By M. Hirschthal
Concrete Engineer, Delaware, Lackawanna & Western Railroad, Hoboken, N. J.

Undertaking a difficult and expensive main line improvement under traffic for the sole betterment of its passenger service, mostly suburban, the Delaware, Lackawanna & Western Railroad is completing one of the outstanding railroad projects of the year. Design features and a description of the project, the new Hackensack River crossing, are contained in the following article. —Editor.

WHERE movable bridges surmount a stream upon which there is a heavy flow of river traffic, there results a great loss of time due to the necessity of repeatedly opening the movable span to permit the passage of such craft as cannot clear the structure when closed.

This is the condition at present existing at the Hackensack River drawbridge of the Morristown line of the Delaware, Lackawanna & Western Railroad, to remedy which there is now under construction a new structure while the present one is still necessarily in operation. The construction of this bridge is the result of an order from the War Department, following its persistent refusal to grant relief to the railroads and therefore to the commuters in their petition to keep the drawbridges closed during the morning and evening rush hours, despite the fact that such closing would but little inconvenience the river interests. The cost of the new bridge, approaches and resulting line changes will be in excess of $3,000,000.

The Hackensack River is crossed by the railroad on a swing bridge about 2 miles west of the Hudson River between Jersey City, N. J., on the east and Kearny, N. J., on its west bank. The present drawbridge provides an underclearance of 12 ft. above high tide and permits the passage of only a small percentage of river traffic without opening. It was this condition that prompted the building of the new structure to afford some relief. A study of the number of openings required for various underclearances resulted in the design of a bridge giving an underclearance of 40 ft. above high water and 43 ft. 3 in. above mean tide. A typical week's river traffic is shown in the accompanying table.

HEIGHT OF VESSELS PASSING HACKENSACK RIVER BRIDGE
Week of Sept. 22-27, 1924

Height	No.	Height	No.
15 ft. to 20 ft.	12	40 ft. to 45 ft.	13
20 ft. to 25 ft.	6	45 ft. to 50 ft.	5
25 ft. to 30 ft.	27	50 ft. to 55 ft.	9
30 ft. to 35 ft.	48	55 ft. to 60 ft.	16
35 ft. to 40 ft.	31		

Of the total of 167 vessels over 15 ft. in height, 124 (75 per cent) were 40 ft. or less in height. Also, a 40-ft. underclearance will permit the passage of the highest tugboat smokestack as well as of all barges and scows.

General Conditions—In order to maintain traffic on the present line until the new bridge could be built, a new line was projected 65 ft. south of the present line, permitting the operation of the present swing bridge without interference with the new construction. This change in alignment is limited on the east end of the work by the Bergen Hill tunnels and on the west by the overhead crossings of the Public Service Corporation trolley line and the Newark Turnpike Viaduct known as Sanfords Crossing at Kearny, N. J.

The new bridge as well as the remainder of the new line will be built for three tracks, similar to the other improvements along the Morristown line, the center track being express eastbound in the morning and westbound in the evening with the flow of suburban traffic.

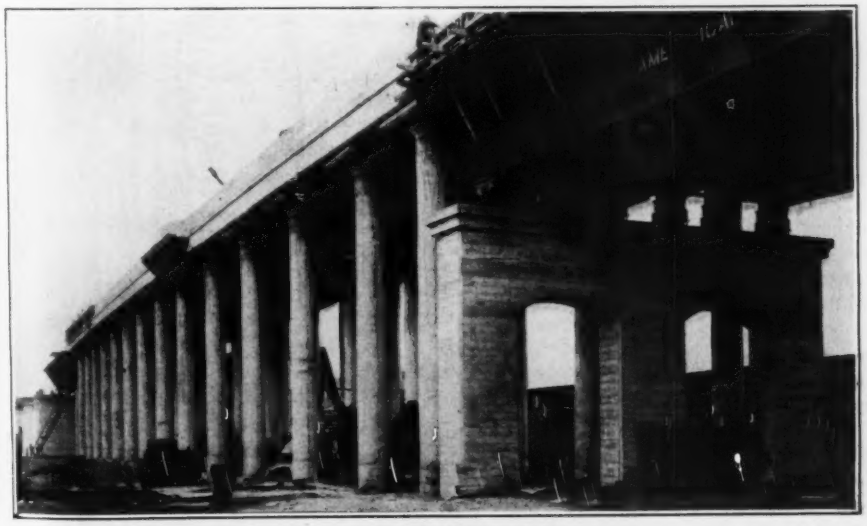


FIG. 1—EAST APPROACH LOOKING TOWARD RIVER FROM DUFFIELD AVE.

The clear width of channel prescribed by the War Department is 150 ft. between fenders measured at right angles to the current, which forms an angle of 76 deg. 2 min. with the new center line, so that the distance on this skew center to center of piers for the main span is 205 ft., resulting in a span of 198 ft. center to center of bearings for the movable bridge. Giving consideration to economy of first cost, facility and rapidity of opening and closing of the movable span, facility and cost

of maintenance and operation, the vertical lift type was selected over a single- or double-leaf bascule type. The remainder of the river is spanned by structural steel deck girders, two for each track, of 110-ft. and 75-ft. spans center to center of bearings, reaching the pier-head lines on each bank of the river.

Approaches—The approaches to the river spans on either flank are of concrete of the girderless flat slab type, although the approach on the east bank, which is by far the more extensive, is interrupted by steel spans where Duffield Ave., Jersey City, is encountered. The construction on the east end is completed by a retaining wall 300 ft. long along the street line of Meadow St. to retain the fill for the new railroad embankment. On the west bank the viaduct approach is flanked by a high fill without retaining walls.

All the steel spans except the movable span are surmounted by solid concrete slabs to provide a continuous ballasted floor from the lift span to the end of the construction on either side. The length of the concrete approach spans, center to center of columns, on the west end is 22 ft. 6 in. longitudinally with the columns 18 ft. center to center transversely, the bents consisting of three columns for a 46-ft. width of slab to carry three tracks 13 ft. on centers, resulting in an overhang of 5 ft. on each side. These panels are all regular and rectangular, and continuous between expansion joints.

The section between the east bank of the Hackensack River and Duffield Ave., Jersey City, is also carried on a flat slab viaduct with the bents 4-E to 16-E all 22 ft. 6 in. center to center longitudinally, while 17-E is made parallel to Duffield Ave., the center line of which crosses the new center line of the railroad at an angle of 78 deg. 7 min. with the tangent to the curve at this intersection. These bents are all three-column bents 18 ft. center to center, similar to those of the west approach.

Inasmuch as it was compulsory to span the full width of 60 ft. of Duffield Ave., this span was made of steel. Because of the location of pipe lines under sidewalks, it was essential that the footings of the piers be kept within the street lines, making it necessary to set the piers supporting the girders back of the street line, which condition in combination with the skew of the angle of intersection increased the span to 75 ft. center to center of bearings. The conditions of design at the east street line were further complicated by difficulty in obtaining the vacation of Meadow St., which runs almost parallel to the tracks and intersects Duffield Ave. under the proposed structure; in addition to this the gas mains of the Public Service Company of New Jersey are carried under the Meadow St. roadway. These difficulties were met by a design of a pier with a heavy cantilever bracket, which supports the girders carrying one track over Duffield Ave. on one side and a similar pair of girders on the other side to a point where the face of the viaduct intersects the Meadow St. line, from which point the concrete viaduct could be continued. (Fig. 7.) This span is also 75 ft. center to center of bearings. Parallel to the latter span are four two-column bents carrying the girderless floor slab in panels more or less irregular and specially reinforced because of lack of continuity transversely. The viaduct is completed by four typical 22-ft. 6-in. bays in a counterforted abutment.

River Piers—One of the most interesting features of this structure is the variety of types of foundation design for the conditions encountered at the various sections. The piers supporting the lift and tower spans were

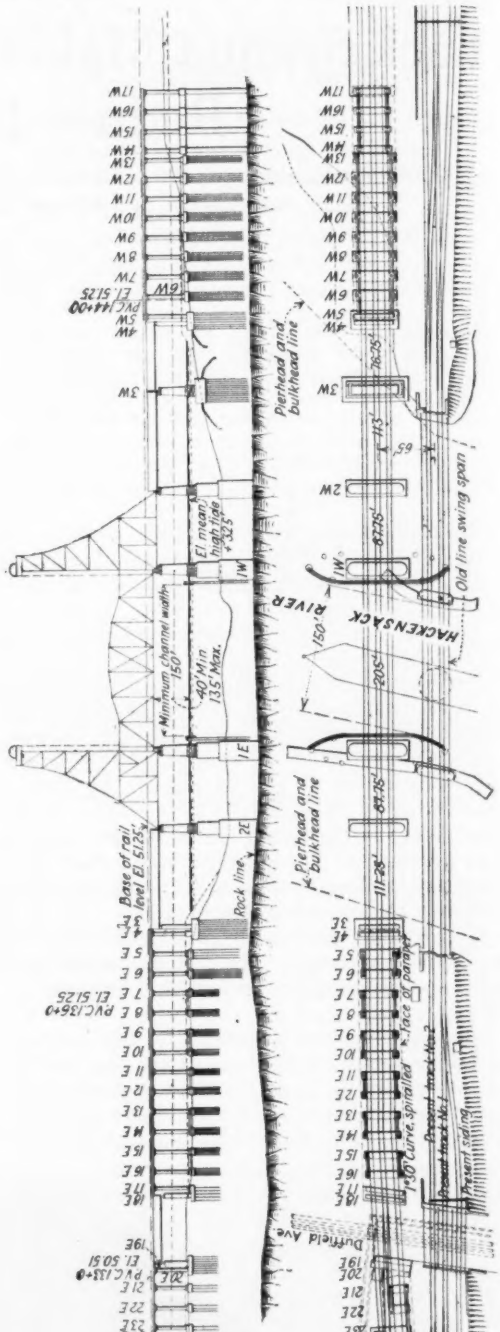


FIG. 2—GENERAL PLAN AND PROFILE OF HACKENSACK RIVER CROSSING

designed to be carried down to solid rock, and pneumatic caissons were chosen over open cofferdams because of the proximity of the present drawbridge abutments. Borings indicated rock at El. —75, but when excavated this proved to be a soft shaly variety, so the caissons were carried down about 15 ft. deeper, where a trap rock was found. (El. —91 for 1-W and El. —89 for 1-E.)

Piers 1-E and 1-W are identical; the dimensions at the base are 22 ft. 3 in. in width, by 71 ft. 3 in. in length, which dimensions are the result of design for full live load on all three tracks together with the tension at the top of towers resulting from the pull on the cables for signals, telephone, future electrification, etc., as well as wind load, which was figured at an angle of 45 deg. to the structure. The maximum resultant pressure at the base is 35 tons per square foot.

The bottom area of the piers is maintained for a depth of 9 ft. 6 in., at which elevation a 1-ft. 1½-in. offset is made, giving a pier section of 20x69 ft. This section is maintained until El. —30 is reached, at which elevation it was thought that the removable cofferdam could be started and a 1-ft. 6-in. offset was provided on each side. Between El. —5.25 and +5.25, which are the extremes of highest and lowest tide ever encountered at this point of the Hackensack River, a protection of granite masonry was provided to guard against damage from

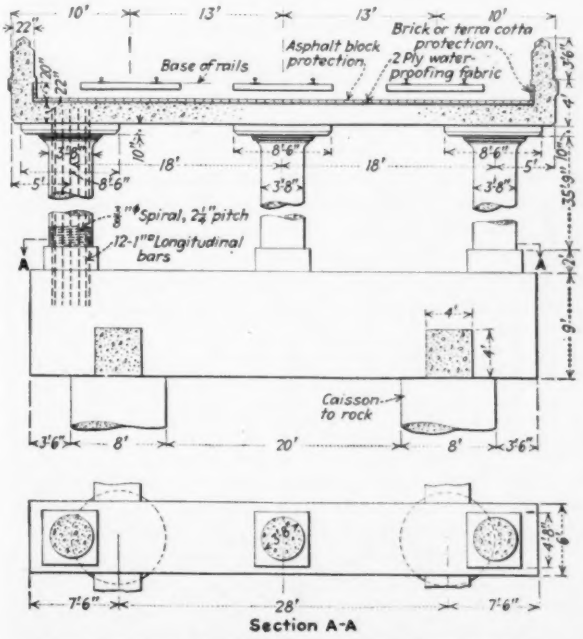


FIG. 3—DETAIL SECTION OF EXTREME WEST END FLAT SLAB

Remainder of flat slab approaches similar except for foundations.

ice or floating débris carried by the swift current. Piers 2-E, 2-W and 3-W, all of which are in the river, were similarly protected.

Pile Foundations—Pier 3-W is founded on timber piles driven to refusal and was designed to be constructed by the open cofferdam method, as were also piers 4-W, 5-W, 3-E and 4-E, which piers carry the steel deck girders of the river portion as well as the columns marking the beginning of the reinforced-concrete viaduct approaches.

All the piers east of 6-E carrying the concrete viaduct on the easterly approach, as well as those carrying the intervening steel girder spans, are carried by cast-in-place concrete piles 25 to 38 ft. long. At 5-E and 6-E, and at all bents on the west approach where lengths exceeding 40 ft. were required, timber piles were used.

Deep Concrete Piers—Because of the great weight of the fill flowing under the viaduct at the west end tending to cause settlement of the soil thereunder, which in turn might cause the settlement of the piles carrying these piers, it was deemed advisable to carry piers 14-W to 17-W inclusive to rock. They are about 8 ft. in diameter and were built by driving sheet piles to rock, excavating and filling with concrete. The piers average 70 ft. deep. This precaution was taken after the foundation failure of a small structure constructed in the early stages of the project some distance west of the river in the treacherous

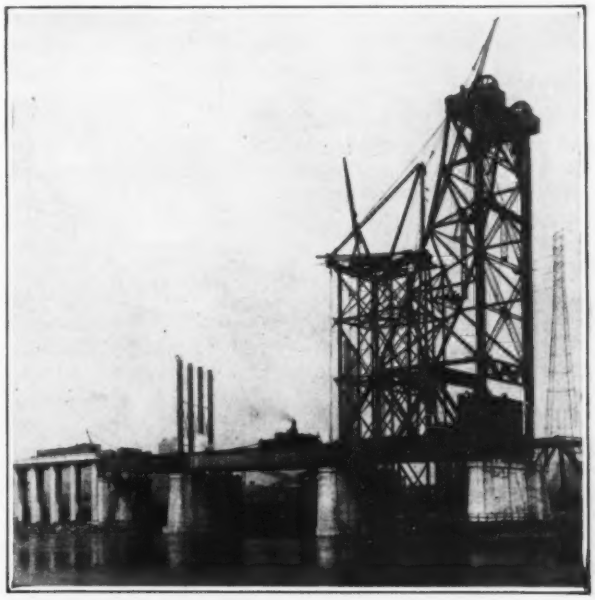


FIG. 4—WEST TOWER DURING ERECTION

Hackensack meadow soil. There are two piers for each bent, tied together by a heavy girder 9 ft. deep by 6 ft. wide, heavily reinforced to take the moments and shears due to the concentrations of column load at the center of the span and the loads of the side columns which are carried in cantilever as well as the superimposed fill carried by the girders.

Essential Details of Superstructures

Lift Span—The lift span trusses are of the Parker type, which is a modified Pratt type with inclined top chords. The counterweight cables are attached by means of adjustable eye-bolts to lifting girders which extend across each end of the lift span and are framed directly to truss hangers.

The trusses of the lift span as well as the towers are spaced 45 ft. center to center to accommodate three tracks 13 ft. on centers and at the same time provide minimum side clearance of 8 ft. from the center lines of outside tracks. The trusses of the lift span have a span length of 198 ft. center to center of bearings with a depth at the center of 48 ft., tapering down to 37 ft. at the hip and the horizontal end member. The floor depth is 8 ft. from base of rail to underclearance, with a depth of 16 ft. from base of rail to top of piers. The maximum movement of the lift span is 95 ft., which gives an open clearance of 135 ft. above high water and places the sheave centers 168 ft. above the top of masonry.

FIG. 2—GENERAL PLAN AND PROFILE OF HACKENSACK RIVER CROSSING

In order to reduce the load of the lift span to a minimum and thus reduce the equipment requirements, an open tie floor was selected rather than a solid concrete waterproofed deck with ballasted track, with which the remainder of the improvement from end to end is equipped. In order to reduce the load still further, silicon steel was specified for the trusses and the floorbeams, with an allowable stress of 22,500 lb. per sq.in. The resulting load requires the use of eight 2-in. diameter counterweighted cables on each of two sheaves of 13 ft. pitch diameter at each corner. The span is operated by means of winding drums located at the middle of the span, the operating ropes being hitched near the top and bottom of the towers and passing over deflector sheaves at each corner and on to the drums. The drums are rotated by

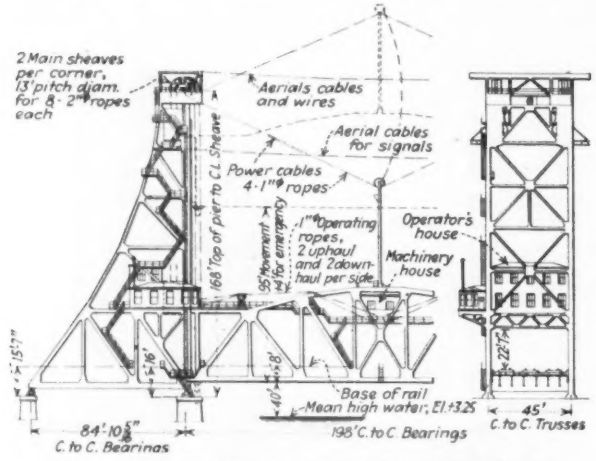

2 Main sheaves per corner, 13' pitch diam. for 8-2" ropes each
Aerials cables and wires
Aerial cables for signals
Power cables 4-1" ropes
1" Operating ropes, 2 uphaul and 2 downhaul per side
Operator's house
Machinery house
68' Top of pier to CL Sheave
95' Vertical lift
45' for emergency
Base of rail
Mean high water; El +3.25
198' C. to C. Bearings
45' C. to C. Trusses
84'-10 5/8" C. to C. Bearings

FIG. 5—DETAIL OF LIFT SPAN AND EAST TOWER

direct-current electric motors and a train of gearing which is located in the machinery house at the center of the lift span. The machinery house is also provided with a gasoline engine with mechanical drive for emergency operation of the lift span.

Air-operated locks to lock the lift span in its closed position are controlled by the railroad signal machine in the operator's house. The operator's house is a two-story building located in the east tower span above the vertical clearance line, the lower floor of which contains the bridge control bench and main control panel board, as well as the signal and interlocking machines, while the generator room houses the transformers, motor generator and gasoline-engine generator sets. The power service line comes from the east and has a connection with three 1,000-kva. transformers in the operator's house furnishing power at 440 volts three phase for operating the motor generator set. An emergency service line comes from the west across the lift span to the east tower. Transformers (5 kva.) provide current for lighting on the main service line and on the emergency line with automatic transfer switches on the secondaries of these transformers so arranged that lighting current ordinarily will be taken from the power service line, but in emergencies it will be switched to the other line. Direct current for lift span motors is supplied by motor generator set, but a stand-by source of direct current is provided by a gasoline-engine generator set.

For carrying the electric cables from the towers to the machinery house at the center of the lift span a steel rocker bent is mounted at the center on top of the lift span, the top of the bent being hitched to the east tower by means of a group of four wire ropes and to the west tower by a continuation of these ropes passing over a sheave on the west tower and held taut by a counterweight. In addition, this arrangement tends to compensate for the unbalancing effect of the rolling of the main ropes from one side of the sheaves to the other when the lift span is raised or lowered. This device is patented.

The signal machine controls the track switches, signals, derails, span locks, locks on span controllers and the locks on the mechanically driven gasoline engine in the machinery house. The span control is interlocked.

The counterweights for the lift span are designed to be of concrete poured into steel boxes, which will act as forms as well as permanent containers. There will be one counterweight on each side, weighing about 610 tons each.

The tower span, the length of which is 84 ft. $10\frac{3}{16}$ in. center to center of bearings, is of the floorbeam-and-stringer type surmounted by a solid concrete deck similar to that covering the remaining river spans, which are of the steel deck-girder type. The depth of girder for the the 110-ft. spans is 10 ft. $\frac{1}{2}$ in., while that of the 75 ft. spans is 9 ft. $\frac{1}{2}$ in., which same design was used for the spans over Duffield Ave. and adjacent to it. These girders were shipped in a solid train of 43 cars.

Flat Slab Design—The remainder of the superstructure is of reinforced concrete of the girderless flat slab type with four-way reinforcement. The various types of construction are separated by expansion joints. Whereas the steel spans were designed as simple spans center to center

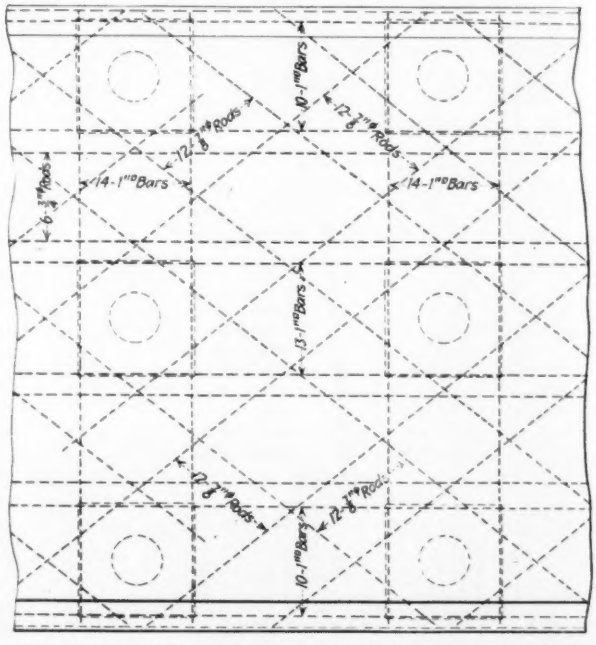


FIG. 6—TYPICAL REINFORCING DETAILS FOR FLOORS OF FLAT SLAB CONSTRUCTION

of their respective bearings, the concrete structure was designed as continuous between expansion joints. The system of spans from one expansion joint to the other was assumed subjected to the loading of two E-65 engines per track followed by a uniform load of 6,500 lb. per linear foot, so placed, respectively, as to give the condition of maximum column reaction for the row of columns adjacent to the end and for the intermediate rows of columns. The columns were made 3 ft. 8 in. diameter, not because of their loading but because of their unusual height, which varies from 36 ft. to 41 ft. These columns

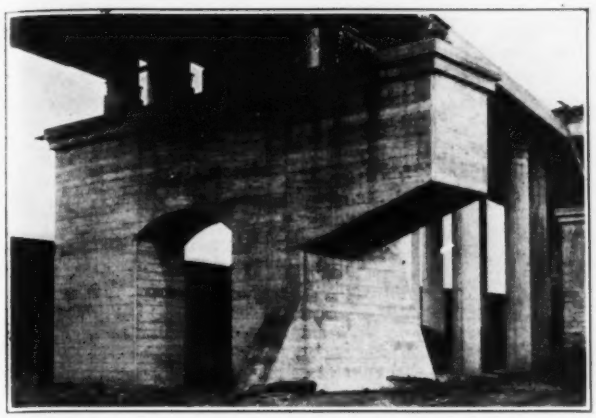


FIG. 7—CANTILEVER PIER AT DUFFIELD AVE.

are reinforced both spirally and longitudinally and each row or bent is supported on a continuous pier resting on either concrete or wooden piles as already described. All the piers are tied together by longitudinal struts of reinforced concrete along the outside rows of columns, and on the west approach, because of the softer soil, by a double set of ties both at the footing level and at the column bases.

For the design of the slab the loadings were then assumed and so placed as to result respectively in the maximum negative moments at the supports adjacent to the ends and over the interior rows of column as well as in the maximum positive moments near the centers of the end spans and at the intermediate spans. To compute the moments transversely a uniform load was assumed so placed along the line of tracks longitudinally as to produce the maximum moments corresponding to those found for the various conditions of locomotive concentrations indicated above, which moments were equated to those resulting from the concentrations, and the equivalent uniform load was thus determined. The track centers being 13 ft. transversely, this equivalent live load was assumed distributed over 13 ft. at the track location on the transverse column system and the maximum live load moments transversely were then arrived at by assuming the conditions respectively of one track loaded, two tracks loaded and all three tracks loaded, and the largest of these designed for. Moments were then found for the dead loads, and when combined with the impact the maximum conditions were obtained.

The next step was the distribution of these moments over the various bands. The maximum positive live load moment longitudinally was considered spread over 13 ft. and resisted by the two half longitudinal bands and the two diagonal bands in inverse ratio of the distance of the center of each band to the center of loading; the resulting moment in the diagonals was increased by the ratio of the spans. Since the diagonals also resist a portion of the moment transversely, one half the average of the transverse moments at the edge of each panel was considered distributed to the transverse and the diagonal bands in proportion to their spans. Where the diagonals were of unequal length, the sum of their portion of the longitudinal and transverse moments was distributed between them inversely as the square of the diagonal spans. The dead load moments were likewise distributed and impact added by formula $LL^2 \div (DL + LL)$.

For the application of these moments for the design of column capitals and the shortening of the span resulting therefrom, they were reduced on the basis of the square of the ratio of the clear span between points near the edge of the column capital and the span center to center of columns approximately similar to the coefficients used by the Chicago Building Code.

The slab was made 1 ft. 10 in. thick, with an additional thickness of 10 in. for the 8-ft. 6-in. square drop-panels; the reinforcing steel was selected to fit the moment requirements, longitudinally, transversely and along the lines of both diagonals, and the required number of bars bent up over the supports and carried into the adjacent panels. Temperature steel was provided in the upper plane in the longitudinal direction. (Fig. 6.)

There are also provided reinforcement and anchor bolts for future catenary supports in the event of the selection of that type of electrification in the future, as well as for signal bridges that are located on the viaduct.

Both for architectural reasons and for the purpose of aiding in the protection of trains in the event of derailment on the viaduct, the balustrades were designed with a heavy cross-section with enough space to accommodate electric light, signal and high-tension lines in the walls on both sides. The electric ducts have pull-boxes at the signal bridges and at the safety niches, which were provided at intervals to permit of protection of a hand car and crew.

Cantilever Pier—One of the features in the design of this structure is the cantilever bracket overhanging the pier on the east side of Duffield Ave. This cantilever acts as the support for the reactions of the girders spanning 75 ft. center to center of bearings on either side, for which purpose its depth was made 14 ft. at the pier, tapering to 10 ft. at the end for an overhang of 12 ft. 6 in. and a width of 7 ft. 6 in. To resist the moment of more than 130,000,000 in.-lb. resulting from the moment of the maximum live load reactions for both spans fully loaded, together with that due to the dead load of the steel girders and deck plus that of the weight of the cantilever itself as well as the impact, there were embedded in the top plane 35 1¼-in. square bars in two layers spread over the 7-ft. 6-in. width—22 bars 3 in. below the surface and thirteen bars 6 in. below. To assist in taking the shear of 1⅓ million pounds, eight ⅞-in. round rods were bent down as diagonal reinforcement, while seventeen sets of stirrups of four each were installed, all to resist the diagonal tension resulting from the shear.

Counterfort Abutment—Another unusual feature is the

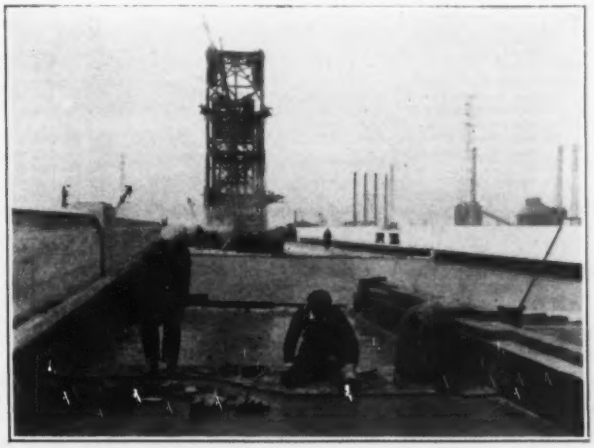


FIG. 8—LAYING WATERPROOFING BLOCKS ON COMPLETED DECK SECTION. EAST TOWER IN BACKGROUND

counterfort abutment completing the viaduct on the east end. To reduce the pressure against this high abutment and at the same time to reduce the load on the footing as well as the eccentricity of the pressure thereon and hence reduce the number of piles required, large openings were provided for the fill to flow through.

The heights of the openings were made to conform to the slope of the fill, and the slab between the counterforts and beyond was reinforced for the varying pressures, the counterforts for the overturning and shear, and the bottom slab to resist the upward pressures with the counterforts as supports. The wall along Duffield Ave. is of the semi-gravity type—that is, supplied with sufficient reinforcement to reduce the section which would otherwise be excessively heavy.

Retaining Wall—This wall is designed for the surcharge of the sloping embankment to the railroad roadbed, on which in addition the live load of engine loading is considered superimposed. The abutment and wall are founded on concrete piles. The assumed earth pressures used in the retaining wall design are shown in an accompanying table.

ASSUMPTION OF EARTH PRESSURES AGAINST RETAINING WALLS AND ABUTMENTS

Height	$\frac{1-\sin\phi}{1+\sin\phi}$	Angle of Repose
1 ft. to 20 ft	0.286	33 deg., 41 min.
20 ft. to 30 ft	0.300	32 deg., 33 min.
30 ft. to 40 ft	0.315	31 deg., 24 min.
Above 40 ft.	0.333	33 deg., 0 min.

The live load concentrations of locomotives are distributed from actual concentrations at an angle of 45 deg. to the wall, the length of distribution being determined by the distance at the intersection of the line of distribution with back of the wall; the load divided by this distance will give the amount of surcharge when divided by the distance between tracks.

Waterproofing and Drainage—The entire deck slab of the structure, including the flat slab viaducts, the floor of the deck girder spans and tower spans, were waterproofed by the application of two-ply asphalt saturated open mesh cotton fabric laid in asphalt covered with an asphalt mopping and protected from damage by the ballast with 8x4x1¼-in. asphalt paving blocks on the flat surfaces and common brick on the vertical sides of the parapets. The slabs were pitched so as to drain off every two panels, on the level portions of the flat slab viaducts the water to be carried by 4-in. openings through the slabs and by pipes down the sides of the columns. The slabs over the steel spans were similarly pitched and provision was made for taking off of the water from these decks.

The columns that will be buried in the fill, as well as the abutment and back of the retaining wall, were coated with a heavy coating of emulsified asphalt, to which was added asbestos fiber to give it additional body for troweling.

A feature of the construction methods used by the contractor on the land portion of the work is the forms used for the construction of the flat slab viaduct. The column forms were made of heavy sheet steel stiffened by angles at the joints and braced diagonally, transversely and longitudinally. The forms from the slab and drop panels were supported by bolts embedded in the permanent columns with structural steel members directly supporting the forms proper at the required levels. (This scheme is patented by the writer.) This obviated the necessity of using long upright members and the difficulty entailed in bracing them.

G. J. Ray, chief engineer of the D., L. & W., directed both the design and construction of all the work. The design of all the work, including that of the lift and tower superstructures and machinery, etc., which were designed by Waddell & Hardesty, consulting engineers, was done under the direction of J. L. Vogel, bridge engineer, and that of the writer, while the construction was supervised by M. H. Doughty as division engineer and W. H. Speirs as resident engineer.

The Foundation Company was the contractor for the pneumatic caissons and other piers of the river portion, while the H. F. Curtis Company constructed the remainder of the masonry work and foundations, except the concrete piles, which were driven by the Raymond Concrete Pile Company.

The lift span and towers as well as the steel girders were supplied by and are being erected by the American Bridge Company.

STRESSES USED IN DESIGN

Pile loadings—wood	15 tons
Pile leadings—concrete	30 tons
Structural steel	16,000 lb. per sq.in.
Silicon steel	22,500 lb. per sq.in.
Reinforced steel, tension	16,000 lb. per sq.in.
Diagonal tension in bent up bars (component of shear)	16,000 lb. per sq.in.
Shearing stresses in stirrups (per prong)	10,000 lb. per sq.in.
Concrete stresses for 2,000 lb. concrete:	
In flexure and compression	650 lb. per sq.in.
In straight compression	500 lb. per sq.in.
Shear	40 lb. per sq.in.
Punching shear	150 lb. per sq.in.
Bond stress—deformed bar	100 lb. per sq.in.

Allowable stress in columns:

$P = f_c \times A + nf_c pA.$

$f_c = f'_c\ (25 + 12\ p').$

P = total load.

f_c = allowable concrete stress in compression.

A = area of core of concrete column.

n = ratio of moduli of elasticity = 15 for 2,000 lb.; 10 for 3,000 lb. concrete.

p = ratio of longitudinal reinforcement.

p' = ratio of spiral reinforcement.

f'_c = ultimate strength of concrete in compression.

For 2,000-lb. concrete (new basis of design), f_c = 500 lb. + 240 lb. per 1 per cent of spiral.

For 1 per cent spiral reinforcement, f_c = 740 lb. per sq.in.; for ½ per cent, f_c = 620 lb. per sq.in.

Stress in longitudinal reinforcement = for 1 per cent spiral, 15 × 740 = 11,000 lb. per sq.in.; for ½ per cent spiral, 9,300 lb. per sq.in.

SUMMARY OF QUANTITIES

Timber piles	1,168
Concrete piles	1,137
Concrete, cu.yd.	35,000
Reinforcing steel, lb.	1,350,000
Structural steel, total tons	3,840
Silicon steel, tons	630
Embankment fill, cu.yd.	600,000

Elements in St. Francis Seepage Water

The tabulation of elements found by chemical analysis in samples of seepage water taken from the west (right) bank just below the St. Francis dam after the collapse was only partly given, due to an oversight, in last week's issue (May 10, 1928, p. 729). The complete tabulation is as follows:

	Aqueduct Water (P.P.M.)	Seepage From Right Bank (P.P.M.)	Ratio Second Col. to First Col.
Chloride	24.00	241.50	10.1
Evaporated solids	294.60	2,319.00	7.9
Silica	35.20	666.20	18.9
Oxides of iron and aluminum	3.00	4.00	1.3
Calcium	35.20	358.80	10.2
Magnesium	7.31	103.19	14.1
Carbonate radical	None	None	None
Bicarbonate radical	87.60	168.36	1.9
Sulphate radical	35.50	1,044.92	29.4
Alkalinity	143.60	276.00	1.9
Sodium and potassium	34.04	125.13	3.7
Hardness	117.97	1,320.08	11.2

In reference to the report published last week attention should be called to the error in the cut caption on p. 726. The caption should read, "Standing Portion and Left Bank After Failure," instead of "Right Bank" as printed.

Los Angeles Will Soon Have 44 Pedestrian Subways

By Robert H. Bacon
With Division of Bridges and Structures, Engineering Department, Los Angeles, Calif.

To Meet the Dangers and inconveniences resulting from heavy automobile traffic, Los Angeles is building pedestrian subways at some of its most dangerous crossings, generally, if not always, near school buildings. The following article, supplementing one on design by the same author in *Engineering News-Record*, June 10, 1926, p. 949, outlines progress in construction under a $350,000 bond issue and gives some details of the subways, their cost, drainage and lighting, and of the benefits which experience shows them to have given. The only other American city that has adopted a pedestrian subway program, so far as we know, is Highland Park, Mich., where a bond issue for such structures was voted in November, 1927. —Editor.

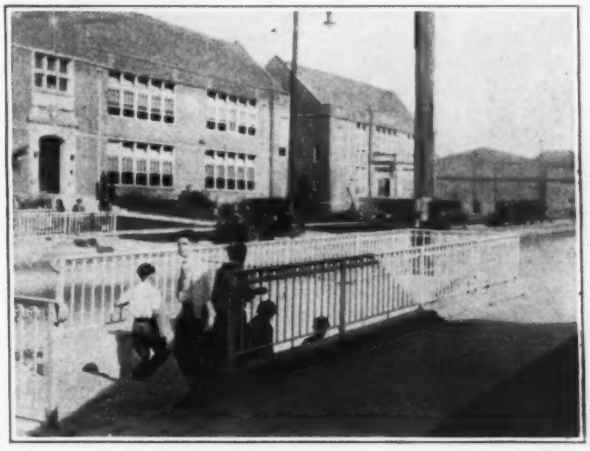
Construction of pedestrian subways near public schools, primarily for the benefit of school children, begun in 1926 under the $350,000 bond issue of 1925, is 86 per cent completed, twenty of the subways having been finished in 1926, fourteen in 1927 and three in January and February, 1928. Plans for three more are finished, but construction will not be started on these until the end of the rainy season, as storm drain reconstruction is required in each case. This makes a total of 40 now constructed or ordered from the $350,000 fund, and it is estimated that there will be only sufficient money left to build one more. With two built in 1918 and one in 1924, Los Angeles will have 44 pedestrian subways when the construction program is completed.

The original cost estimate was $10,000 per subway. The first three averaged slightly less than $7,000 each, which gave hope that about 50 could be built from the fund. It developed, however, that the contractors were bidding too low, the competition being keen and the difficulties of construction perhaps not fully appreciated. The average cost of each of the next 30 subways was $8,100, the increase being due to a rise in the scale of bidding and also to the fact that several of the subways were considerably longer than the average and several involved storm drain and sewer reconstruction work. All cost figures are for total expense, including contract price, engineering, inspection and extras. The total cost of the 37 subways now finished was $301,219, an average of about $8,150 each. If length of approach steps is included as part of the length, the cost per linear foot runs from $42.69 to $99.70, the average for the 37 subways being $57.35. One of the subways passes under six parallel tracks of the Pacific Electric Railway and is more than 300 ft. in length. Its cost was $19,558.

Of the 37 subways now built, 24 drain into the sanitary sewer system; eleven drain into sumps from which the water is removed by automatic water ejectors operated by a 1-in. service pipe attached to the city mains; one has an electrically driven bilge pump, and one drains into a sump which discharges through a 6-in. pipe directly into the gutter of a street or a steep hill. The ejectors and bilge pump require a small amount of maintenance service. The glass doors of lighting recesses are occasionally broken and require replacement. Regular sweeping and flushing service is given all subways by city forces. A few of the subways are of such length that it is necessary to have the lights near center going continuously. All the subways are fully lighted at night. The rough spatter-dash plaster finish for walls has proved a success in preventing the usual scribbling which occurs in such places. The surface is made extremely rough and lumpy but uniform in texture.

The use of the subways by the school children is practically 100 per cent. The anxiety of many parents of small children has been greatly relieved by the knowledge that a safe means is always at hand for them to cross the busy thoroughfares on their way to and from school. About 37 police officers who guarded the crossings before the subways were built have been assigned to other duties. Many adults are also using certain of the subways located where the traffic is constantly heavy. That the benefit of these subways to the motoring public is well nigh inestimable can scarcely be questioned by anyone who drives a car in Los Angeles.

The completion of the present program will relieve more than 40 of the worst locations, but there still remain at least an equal number where subways would be of great benefit, several such locations having developed within the last year. Many petitions asking for subways from residents in different localities have been received by the council and are held in abeyance pending financing.



CHILDREN ENTERING PEDESTRIAN SUBWAY TO REACH SCHOOLHOUSE ACROSS THE STREET

Los Angeles will soon have 44 of these subways, of which 41 will have been built from the proceeds of a $350,000 bond issue, authorized in 1925. Their primary object is the safety of school children, but they also facilitate the movement of vehicles.

The author has examined and reported on a considerable number of such locations, both adjacent to schools and otherwise. At one of these in a suburb about 10 miles from the center of the city where a traffic artery to the San Fernando Valley passes through a local business section and where a primary school is located about one block from the main highway and more than 500 of the pupils must cross and recross the highway to their homes, the author counted the following vehicles in a space of 25 minutes from 9:20 a.m. to 9:45 a.m.: Sand and gravel trucks, 54; other trucks, 35; buses, 6; ordinary automobiles, 269; total in 25 minutes 364, or 14.5 per minute or one every 4.1 seconds on an average.

The subways were designed in the division of bridges and structures of the Engineering Department of the City of Los Angeles, John C. Shaw, city engineer; R. W. Stewart, chief deputy city engineer, and Merrill Butler, engineer of bridges and structures. The writer had charge of the details of designing and planning.

Engineering Literature

A Monthly Review of Books and a Listing of New Publications

Ground-Water Lowering Methods

REVIEWED BY ABEL WOLMAN
Chief Engineer, Maryland Department of Health; Editor Journal American Water Works Association, Baltimore, Md.

DAS FASSUNGSVERMÖGEN VON ROHRBRUNNEN und seine Bedeutung für die Grundwasserabsenkung, insbesondere für grobere Absenkungstiefen—Von Dr. Ing. Willy Sichardt, Regierungsbaumeister a.D. Oberingenieur der Siemens-Baunnion. Berlin, Germany: Julius Springer. Paper; 6x9 in.; pp. 89; 40 line cuts and halftones in text. 7.5 reichmarks in Germany.

The problem of estimating the flow of ground water under different conditions of hydraulic gradient and character of soil has been the subject of many discussions and empirical formulas for many years. For the most part, the demand for mathematical solutions to this problem has come from the field of water-supply development. In latter years, however, the practice of handling the excavation for foundations in water-bearing soils by lowering the ground-water levels by pumping from well-point has added a new incentive to the search for empirical predictions of a mathematical character regarding the probabilities of ground-water lowering by pumping.

Terzaghi (*Journal* Bos. Soc. C.E., September, 1927, p. 393) has recently pointed out the lag in America in adopting the well-point method of excavation for practically all permeable soils, a procedure long since analyzed theoretically and empirically in considerable detail abroad and particularly in Germany. Forecasting and comprehensive checking of actual conditions during excavation with well-point lowering of water levels have resulted in the development of a technique that augurs well for successful performance, even though the complexity of forecast methods may be disheartening to some contractors.

The present volume is the most recent contribution to the elucidation of a series of mathematical solutions to the problems of ground-water lowerings by various pumpages and under varying conditions of soils and of arrangement of well-points. The author reviews briefly the implications of the problem, with particular reference to foundation work, and refers in detail to previous contributions to the literature of ground-water flow *per se* and in relation to excavation procedure. The bibliography of important work in continental Europe listed in this connection is impressive.

The volume is then concerned, for approximately three-quarters of its entire length, in the development of empirical solutions of equations derived primarily from Darcy's well-known formula for ground-water flow. A careful review of the contributions in this field by Darcy, Smreker, Forchheimer, Prinz, Kyrieleis, Slichter and others leads the author to the acceptance of the fundamental equation of Darcy as the basis for further calculations. The studies by Hazen on the same problem seem to have been overlooked.

The detailed and quite complicated mathematical developments of the equations of flow under different assumptions are indications as much of the highly developed state of the art as they are of the German method of attack. The book carries forward in much greater detail the simpler procedures and problems of earlier texts, such as Brinkhaus (Anlagung zur Gewinning von naturlichem und Kunstlichem Grundwasser). Helpful graphical solutions of complex hydraulic equations serve to make the volume of added practical value, particularly in the interesting graphical analysis of the primary equation of ground-water flow: $Q = \pi K \frac{H^2 - h^2}{\log_e \frac{R}{r}}$ giving the relation between yield, depression, radius of circle of influence of well and character of soil. An excellent bibliography is appended.

It is interesting to note here an independent and much briefer mathematical analysis of the radius of circle of influence of wells by Yoshida (Kumamato Technical College, Japan, Bulletin No. 1, May, 1926).

Two Books on Highway Engineering

HIGHWAY ENGINEERING: A Study for Students of Civil Engineering—By John H. Bateman, C.E., M.Am.Soc.C.E., Research Professor of Highway Engineering, Louisiana State University. New York: John Wiley & Sons, Inc. London: Chapman & Hall. Cloth; 6x9 in.; pp. 418; Numerous halftones and line cuts. $4.

PRINCIPLES OF HIGHWAY ENGINEERING—By Carroll Carson Wiley, C.E., M.Am.Soc.C.E., Assistant Professor of Highway Engineering, University of Illinois. New York and London: McGraw-Hill Book Co., Inc. Cloth, 6x9 in.; pp. 510; 227 line cuts and halftones. $4.

Although nearly identical in title, these two books differ widely in subject matter and in method of presentation. Both are offered primarily as textbooks, but would make valuable reference books for those in practice. The first presents the administration and economics of highway building, as well as details of actual construction. The second is really an exhaustive study of materials used in road work and a detailed description of the construction of each of the numerous types of highways. Both books are well illustrated, and have actual problems at the end of each chapter.

Tracing the development of roads from ancient to modern times, the author of Highway Engineering shows how road building has kept pace with civilization. The growth of the highway system of this country is shown by states, with full use of tables and charts. As with railways, the author states, no highway should be improved by expenditure of funds in excess of its earning capacity. The return to the public in the form of economical transportation is the sole measure of justification for the degree of improvement.

Looking at a project as a part of a highway system rather than an individual stretch of road, Professor Bateman stresses the need of traffic surveys and an intelligent use of the data so acquired in determining the location, cost, type and capacity of highway improvements. A valuable discussion of highway financing is given, both for urban and rural districts.

Going into actual road building, the author describes the various steps in chronological order from location surveys to opening the road to traffic. The construction of each type of road is briefly considered, both foundations and wearing surfaces. Road-building machinery is de-

scribed, as well as materials, their sources and preparation for use.

Taking again the administration viewpoint, the book closes with a study of traffic conditions on existing roads, methods of policing, use of stop lights and control of traffic. The prevailing use of contracts, specifications and methods of testing are treated in appendices.

Professor Wiley, in his Principles of Highway Engineering, has gone into a detailed study of road-building materials and types of construction. Every characteristic of all known materials is commented upon. As an example, earth as a road material is subdivided into clays, colloidal clays, silt, sand and humus, and each is discussed with further subdivisions. A considerable portion of the book is devoted to similar treatment of the various bituminous and non-bituminous materials. Reinforcing steel and paint even receive a place. The author has probably gone into more detail than is necessary in this discussion of materials.

The proportioning of concrete mixtures takes up a chapter, with mention of plant used and methods of placing and curing. Further chapters are devoted to earth work and grading.

The construction of every type of road and pavement, sub-bases and wearing surfaces is discussed completely. Much mention is made of the machinery in present-day use. Highway and street accessories receive prominence in chapters on drainage, bridges, curbs, gutters and sidewalks. The resurfacing and repairs of old roads are treated thoroughly. The author deals with horizontal and sectional alignment from a technical standpoint. Final chapters deal with brief discussions in comparison of roadways, highway financing and operation.

Sewage Treatment Clearly Outlined

THE DISPOSAL OF SEWAGE: A Textbook for the Use of Engineers, Sanitary Inspectors and Students—By T. H. P. Veal, B.Sc., A.M.I.C.E., Lecturer in Civil Engineering at the University of Birmingham [England]. New York: D. Van-Nostrand Co. Cloth; 6x9 in.; pp. 173; illustrated. $4.25.

The essentials of sewage treatment are here clearly outlined. That the outlook of the author and most of his illustrative examples of practice are British add to the value of the book for readers outside Great Britain, all the more so because practice in other countries is not overlooked.

A glance at the contents of the volume and the order of their presentation will show how nearly universal are the fundamentals of sewage treatment today. After a historical chapter the author takes up sewage quantity and analyses, preliminary processes, sedimentation, bacteria beds, bio-aeration (activated-sludge process), land treatment, sludge disposal, plant layout and costs, and rural problems.

Of adverse criticism, we mildly suggest that even for British students and junior engineers parts of the historical matter on the numerous royal commissions might better be given way to a succinct exposition of the objects and limitations of sewage treatments, or that if so much was to be quoted from the reports a few words might well have been introduced to show how wrong some of the conclusions were from the viewpoint of present knowledge and conditions. Besides this mild adverse criticism, we object strongly to the use of Bio-Aeration Tanks as the title for the chapter on the activated-sludge process. The latter term is established historically, is used almost exclusively in the United States and Canada —where altogether there are perhaps three or four times as many activated-sludge plants as in England, with probably twenty times the aggregate capacity.

These are small matters in a book which otherwise might well serve as a model for the presentation of the fundamental principles and most accepted practices in a single branch of engineering.

Translated and Altered for Americans

REVIEWED BY D. D. KIMBALL
Consulting Engineer, New York City

HEATING AND VENTILATION: A Handbook for Architects and Engineers—By C. W. Brabbee. Translated for American Use from the Seventh German Edition of Rietschel-Brabbee, "Heizungs-und Luftungstechnik." New York and London: McGraw-Hill Book Co., Inc. Cloth; 6x9 in.; pp. 333; 187 figures in the text, 1 folding plate, and 6 folding "charts" and tables in pocket. $4.50.

In this translation, for American use, of the Seventh German Edition of Rietschel-Brabbee, "Heizungs-und Luftungstechnik," there has been incorporated something of American practices, while some of the German practices not applying to the American field have been omitted. There is much in the book that will prove of interest to the student of heating and ventilation and much, too, that will be helpful to the practicing heating and ventilating engineer.

The general arrangement of the book is something new to American engineers, consisting essentially of four divisions: (1) A general description of requirements, methods and appliances relating to heating and ventilating; (2) details of the design of heating and ventilating systems; (3) a list of essential tables; (4) seven loose-leaf charts. To the student new in the study of this subject the first division of the book especially will prove interesting and helpful, and to the advanced student and practicing engineer the second, third and fourth divisions will give valuable formulas and data. The thoroughness and detail of German engineering are well illustrated, methods that may not appeal to the American drafting room engineer with his ready-to-use charts, tables and brief formulas.

Not the least interesting feature of the book is the indication of future editions, for there is some evidence that in the consolidation of the original two volumes into one some subjects have been left too briefly treated, and the reader is too often referred to other treatises on certain essential phases of the subject. Then, too, a future edition may be expected to refer more generally and specifically to American and less to German practices and appliances that are not applicable or available in the American field.

Hot water heating installations are undoubtedly worth while, but so are the prevailing American tendencies to use vacuum heating systems; therefore it is hoped that a later edition of this book may more correctly relate the relative amount of space given to these two heating systems, to fit more definitely to American practices. Then, too, we here practice more generally the downward flow of air in our best auditoria ventilating work, a method probably brought to us by that most able ventilating engineer, A. R. Wolff, rather than the upward flow of air that is advocated by the author of this book. Cooling and drying air is too vast a subject to be treated fully in four or five pages, although what is said is helpful and well worth while. Similarly the

subject of chimneys is helpfully but too briefly treated herein.

Little in the book, and that limited to German methods and appliances not practical or available here, could well be omitted, and considerable might be added in the way of our always-at-hand American tables, charts and sketches, as well as further illustrations of American equipment and methods. No library on the subject of heating and ventilation, either of student or practicing engineer, may be deemed complete which does not contain this book, for there is much therein that will be helpful to all interested in American literature upon this subject.

International Economic Conference

VERLAUF UND ERGEBNIS der Internationalen Wirtschaftskonferenz—Compiled by Dr. E. Respondek. Berlin: Carl Heymanns. Paper; 8x11 in.; pp. 400.

Dr. Respondek's compilation of the proceedings of the International Economic Conference, held in Geneva in May, 1927, is excellent. The principal addresses are given in full and all other addresses, both in the plenary and in the division sessions, in generous abstract. The discussion in the committees and sub-committees are given ample space, so that the full import of each delegate's and expert's views is conveyed to the reader. The general proceedings of the conference are reported in full, as is also the very important summarizing closing speech of the president, M. Theunis. Valuable additional features are the report of the session of the Council of the League of Nations, at which the work of the conference was reported to the league, and the official statements of various European governments as to their opinion of the work of the conference and their intentions with reference to adoption of the conclusions. The report is made conveniently usable by excellent and generous indexes. All in all, the book is a model of what a summary of an outstanding world meeting should be. It is an invaluable document to anyone who studies world developments and who can read German.

New Books and Revised Editions

[Those desiring copies of the books listed below or mentioned elsewhere in this section should order them from the publishers or from their local booksellers.]

A THEORY OF SILT AND SCOUR—By William Maurice Griffith, with an Abstract of the Discussion on the Paper. Westminster, England: Institution of Civil Engineers. Paper; 6x9 in.; pp. 171; line drawings.

DER BAUSTOFF UND SEINE VERARBEITUNG. Vierte Neubearbeitete Auflage. Der Beton, Betonmischmaschinen, Fördern und Verarbeiten von Beton, Das Eisen und Seine Verarbeitung, Schalung und Rustüng—Bearbeitet von H. Burchartz, Professor; E. Jordan, Dipl.-Ing.; H. Schluckebier, Regierungsbaumeister a.D.; O. Rappold, Baurat. Berlin: Wilhelm Ernst & Sohn. Paper; 7x10 in.; pp. 427; 605 illustraflons, mostly line cuts. 26 reichmarks.

BERECHNUNG: vielfach statisch unbestimmter biegefester Stab- und Flächentragwerke—(I Tiel) Dreigliedrige Systeme, Grundlagen u. Anwendungen—By Dr.-Ing. Peter Pasternak, Privatdozent für technische Baustatik und Eisenbetonbau an der Eidgen. Techn. Hochschule in Zurich. Zurich und Leipzig: Gebr. Leemann & Co. Paper; 6x9 in.; pp. 273; 3 tables; illustrations. 13 reichmarks in Germany.

BETHLEHEM STEEL JOISTS AND STANCHIONS for Dwellings, etc., 1928. Weights, Dimensions, Properties, Safe Loads, Spacing of Joists. Bethlehem, Pa.: Bethlehem Steel Co. Flexible; 4x7 in.; pp. 70; line cuts.

BUILDING ORDINANCES OF THE CITY OF CHICAGO, with amendments to Jan. 16, 1928. Chicago: Municipal Reference Library. Paper; 5x8 in.; pp. 384. 50c.

CALCUL DE LA PERTE DE CHARGE DUE AUX TUYAUX TRONC-CONIQUES—Par D. Kestlicher, Ingenieur A.I. Lg., Assistant Privé de M. Ch. Hanocq, Professeur à l'Universite de Liége. From Revue Universelle des Mines, December, 1927. Liége: Vaillant-Carmanne. Paper; 6x9 in.; pp. 213; diagrams.

A study of the loss of head in tapering pipes, as in some pump installations, or as in the Venturi meter.

DACHBAUTEN: SCHALEN UND RIPPEN-KUPPELN—Bearbeitet von H. T. Kraus und Fr. Dischinger. [Third Edition of Part XII of Handbuches fur Eisenbetonbau, F. Emperger, Editor.] Berlin: Wilhelm Ernst & Sohn. Bound; 7x10 in.; pp. 378; with 560 text illustrations, mostly line cuts. 28 reichmarks in Germany.

DER ELASTISCH DREHBAR GESTÜTZTE DURCHLAUFBALKEN: (durchlaufenden Rahmen) Gebrauchsfertige Zahlen für Einflusslinien und Grösstwerte der Momente—By Dr.-Ing. H. Craemer, Düsseldorf. Berlin: Julius Springer. Paper; 7x8 in.; pp. 28; with tables and 7 line cuts. 5.1 reichmarks.

THE EMPIRE MUNICIPAL DIRECTORY AND YEAR BOOK, 1928-29. 46th Year of Publication. London: Municipal Engineering and Sanitary Record. Cloth; 7x9 in.; pp. 328. 10½ sh. in England.

Covers Great Britain, its colonies and dominions; besides directory features, has sections on "municipal engineering and public health work and progress."

ENGERER WETTBEWERB UM ENTWÜRFE FÜR EINE FESTE STRASSENBRÜCKE ÜBER DEN RHEIN IN KÖLN-MÜLHEIM—By Dr.-Ing. O. Kommerell Direktor bei der Reichsbahn, Berlin, und Dipl.-Ing. W. Rein, Berlin. Berlin: Julius Springer. Paper; 9x12 in.; pp. 107; 222 illustrations. 6 marks.

THE ENGINEERING INDEX, 1927—New York: American Society of Mechanical Engineers. Cloth; 7x9 in.; pp. 898. $7.50 to members of the society named above; $8.50 to non-members.

Continuation of the great service of indexing engineering and allied periodicals begun over 40 years ago by the Association of Engineering Societies, continued by *The Engineering Magazine* and by the above-named society. Future indexes will be far more inclusive and larger; a weekly service is available.

DIE ERDBEBENSICHERHEIT VON BAUWERKEN—Von Dr.-Ing. Rudolf Briske, Regierungsbaumeister, a.D. Erweiterte Sonderdruck aus der Zeitschrift "Die Bautechnik," Jahrgang 1927. Berlin: Wilhelm Ernst & Sohn. Paper; 10x14 in.; pp. 32; 80 halftones and line cuts. Paper, 5 m., in Germany.

HERBERT HOOVER: A Reminiscent Biography—By Will Irwin. Cloth; 6x8 in.; pp. 315; half tones. $3.

MANUAL OR TRIANGULATION COMPUTATION AND ADJUSTMENT—By Walter F. Reynolds, Mathematician, U. S. Coast and Geodetic Survey. Paper; 6x9 in.; pp. 242; illustrations and tables. 50c. from Superintendent of Documents, Washington, D. C.

Describes standard practices in use from field abstracts of observations to tabulation of final results. Earlier publications take up triangulation, traverse and gravity observations. A manual on first-order leveling is proposed.

LE MOLLE—Ing. Piero Gradenigo, Professore di Costruzione di Macchine e di Meccanica Applicata alle Macchine nella Scuola di Ingegneria Navale di Genova. [Biblioteca Tecnico-Industriale.] Paper; 7x10 in.; pp. 731; 54 tables; 422 illustrations in text and on folding plates, from line drawings by the author. Torino, Italy: S. Lattes & C.

A comprehensive treatise on the theory and manufacture of springs, written in Italian.

MOTOR TRAFFIC MANAGEMENT—By G. Lloyd Wilson, Ph.D., Assistant Professor of Commerce and Transportation, Wharton School of Finance and Commerce, University of Pennsylvania; formerly traffic manager of the Chester Ship Building Co., Ltd., and the Merchant Shipbuilding Corporation; author of "Traffic Management," etc. New York and London: D. Appleton & Co. Cloth; 6x9 in.; pp. 251; 56 line cuts. $3.

PRINCIPLES OF MECHANISM: By F. Dyson, A.C.G.I., B.Sc. (Hons.) A.M.I., Mech. E. Lecturer in Mechanical Engineering at the City and Guilds (Engineering) College Imperial College of Science & Technology, London. New York: Oxford University Press New York Branch. Cloth; 6x9 in.; pp. 296. 148 line cuts. $4.25.

A British book for students working for an engineering degree or preparing "for examinations by the Engineering Institutions, and for those studying under the joint scheme for National Certificates and Diplomas."

RÄUMLICHE VIELECKRAHMEN MIT EINGESPANNTEN FÜSSEN: unter besonderer Berücksichtigung der Windbelastung—By. Dr.-Ing. Alfred Millies. Berlin: Julius Springer. Paper; 6x9 in.; pp. 96; 53 line cuts. 12 reichmarks in Germany.

VERSUCHE: Über Den Einfluss Niederer Temperatur auf die Widerstandsfähigkeit von Zementmörtel und beton. Ausgeführt in der Materialprüfungsanstalt an der Technischen Hochschule Stuttgart. In der Jahren 1920 bis 1926. (Deutscher Ausschuss für Eisenbeton)—By Otto Graf. Berlin: Wilhelm Ernst & Sohn. Paper; 10x8 in.; pp. 44; 55 halftones and line cuts. 52 reichmarks in Germany.

VESTIGES OF PRE-METRIC WEIGHTS AND MEASURES Persisting in Metric-System Europe, 1926-1927—By Arthur E. Kennelly, Professor of Electrical Engineering at Harvard University. [Bureau of International Research of Harvard University and Radcliffe College.] New York: The Macmillan Co. Cloth; 6x8 in.; pp. 189. $2.50.

WATER!—By Albert Payson Terhune. New York and London: Harper & Brothers. Cloth; 5x8 in.; pp. 218. $2.

A novel of adventure in water-supply exploitation with an engineer as hero. To be noticed at more length in a later issue.

Letters to the Editor

A Forum for Discussion of Views of Engineers and Contractors

An Answer to St. Francis Criticism

Sir—So many plausible explanations have been offered as to the cause of the failure of the St. Francis dam by engineers and others who have not seen the site that the discussion has become quite confusing in the mind of the ordinary lay engineer.

One of the first principles of dam construction is to have a tight skin next to the water surface and have this supported by a mass of either concrete, solid or arched buttresses, loose rock or earth. The remedy suggested by J. W. Ledoux in your issue of April 19 of building a cutoff wall under the downstream toe of the dam is certainly no cure of the problem. The construction of a deep cutoff wall on the downstream toe would lead to inevitable destruction. The correct place to put the proper cutoff toe is under the upstream slope, vertically down to a tight bedrock. This should be supplemented, if necessary, with free drainage underneath the body of the dam, to permit any seepage water to flow harmlessly away in drains with a gravity velocity.

St. Francis dam being in the shape of an arch and the central 80 ft. of the arch remaining is a strong indication against the theory of sliding. Undoubtedly the west wing was undermined by seepage water through the porous sandstone, which promoted fracture and ultimate destruction.

San Francisco, Calif., April 27, 1928. M. M. O'SHAUGHNESSY, Consulting Engineer.

Temporary Flood Storage Calculated by Analytical Method

Sir — Referring to the graphical method of reservoir spillage analysis described in the article "Graphics of Temporary Flood Storage," by Raymond A. Hill, in your issue of April 26, 1928, p. 657, the writer presents herewith as a matter of comparison his analytical solution of the same problem. A discussion of the principles of the analytical method used may be found in *Engineering News-Record* on p. 135 of the issue of July 28, 1927, and on p. 607 of the issue of Oct. 13, 1927.

The analytical method of treatment appears to the writer as shorter, simpler and more direct and accurate than any possible graphical solution, and the results are in numerical form compactly arranged for filing and reference. The process involves no "cut and try" assumptions and adjustments, as each step is positive and definite.

The following analysis is made in ten-hour intervals.

The first step in the application of the writer's method is the plotting of a q $(S + q)$ curve from the first and last columns of the table in Mr. Hill's article, which give the total amount of storage in the reservoir and the combined outflow from all outlets at corresponding levels. The writer has retained the acre-foot storage unit and hence q must be expressed in acre-feet per five hours and is obtained by multiplying the figures in the final column of Mr. Hill's table by 0.4132.

The quantities used in the analysis are denoted by symbols as follows: S_y = reservoir storage at end of ten-hour period (acre-feet); q_y = outflow rate at end of ten-hour period (acre-feet per five hours); S_x = reservoir storage at beginning of ten-hour period (acre-feet); q_x = outflow rate at beginning of ten-hour period (acre-feet per five hours); F = inflow during ten-hour period (acre-feet).

$S + q$ at the end of each ten-hour period is obtained from the following equation:

$$S_y + q_y = S_x - q_x + F$$

Knowing $S + q$, the corresponding q is obtained from the diagram already drawn. $S + q$ is then converted into $S - q$ for the next step forward by the subtraction of $2q$. F is taken from the inflow mass curve (Fig. 4 of Mr. Hill's article).

The computation progresses as follows: Column 3 is filled in from the known inflow data. The initial $S - q$, 115,760, = the initial storage minus the initial outflow rate. 115,760 + 1,500 = 117,260. From the diagram the corresponding q = 1,240.

117,260 — 1,240 — 1,240 = 114,780. 114,780 + 13,500 = 128,280. Corresponding q = 2,040.

128,280 — 2,040 — 2,040 = 124,200.

124,200 + 26,500 = 150,700, etc., etc.

The figures of Column 6 are the sums of the adjacent q's.

The outflows in Column 6 are subtotaled in Column 7 to check the outflow mass curve of Fig. 4 of Mr. Hill's article.

Albany, N. Y., May 3, 1928. MELVIN D. CASLER, Designing Engineer, Hudson River Regulating District.

CALCULATION OF TEMPORARY FLOOD STORAGE

Cumulative Time (Hours) (1)	$S - q$ (2)	F (3)	$S + q$ (4)	q (5)	Outflow in Ten-Hour Periods (6)	Acre-Ft. Cumulative (7)
0	115,760		118,240	1,240		0
		1,500			2,480	
10	114,780		117,260	1,240		2,480
		13,500			3,280	
20	124,200		128,280	2,040		5,760
		26,500			6,690	
30	141,400		150,700	4,650		12,450
		37,000			10,890	
40	165,920		178,400	6,240		23,340
		48,500			18,240	
50	190,420		214,420	12,000		41,580
		14,000			21,200	
60	186,020		204,420	9,200		62,780
		7,500			16,120	
70	179,680		193,520	6,920		78,900
		5,000			13,440	
80	171,640		184,680	6,520		92,340
		4,000			12,640	
90	163,400		175,640	6,120		104,980
		3,500			11,790	
100	155,560		166,900	5,670		116,770
		3,500			10,890	
110	148,620		159,060	5,220		127,660
		2,500			9,900	
120	141,760		151,120	4,680		137,560
		3,000			8,830	
130	136,460		144,760	4,150		146,390
		2,500			7,520	
140	132,220		138,960	3,370		153,910

Parabolic Truss Bridges—Some Early Facts

Sir—In your issue of May 10, 1928, is an article by Robins Fleming entitled "Parabolic Truss Bridges," which gives the history of the double parabolic form of bridge truss in this country and mentions that a patent dated April 16, 1878, had been granted for it to William O. Douglas, of Binghamton, N. Y.

Inasmuch as this form of truss was used in Germany as early as 1857 and in England in 1859, it is obvious that the American patent was worthless. Suit for infringement of that patent was threatened (but did not go further) against the owners of the Smithfield St. bridge in Pittsburgh over the Monongahela River, which I built in 1881-82 and an account of which is contained in *Transactions*, Am.Soc.C.E., Vol. 12, p. 353 (1883). The paper received the first Rowland prize in 1883.

It is remarkable that Mr. Fleming did not mention the Smithfield St. bridge, since it has the longest spans—two spans of 360 ft. each—of that type in this country and is still in use. Only the Saltash bridge in England, by Brunel, had longer spans of this type, 455 ft.

The Monongahela bridge was the first in which open-hearth steel was used for the compression chords and also for the tension chords, which have the heaviest forged eyebars obtainable at that time. They were made by the Kloman process and by the same hammerman who forged the wide, wrought-iron eyebars for the Eads bridge at St. Louis in 1872. G. LINDENTHAL.

New York City, May 11, 1928.

News of the Week

Current Events in the Civil Engineering and Contracting Fields

A.G.C. Board Acts on Association Problems At Its Spring Meeting

Considers Holding Annual Meeting on Steamship From San Francisco to New York

AT THE spring board meeting of the Associated General Contractors held at Washington, D. C., May 7-10, substantial advance was made in co-ordinating thought and action on the several problems that have occupied organized contracting in recent years. Standard lien law activities, surety bonding practices, relations with sub-contractors, accident prevention and credit policies were all forwarded toward ultimate settlement. The meeting witnessed the induction into office of the new general manager, Daniel A. Garber, and passed a resolution of thanks to R. C. Marshall, who retired as general manager to enter private business on May 1. Selection of the "Twin Cities"—St. Paul and Minneapolis—was made for the fall board meeting. Decision on the place for the annual convention of 1928 was deferred until the possibilities of attendance could be ascertained for a shipboard meeting involving a sixteen-day voyage from San Francisco via the Panama Canal to New York.

PLACE OF CONVENTION

Decision had been made by the executive board to hold the convention in Chicago. However, on presentations by the California members the announcement was held in abeyance until the Northern California Chapter could formulate a plan for a shipboard meeting to be presented at the spring board meeting. As presented by E. G. Lloyd, manager of the chapter, and advocated by President W. A. Bechtel, the suggestion was to hold the convention on board the steamship "California," sailing from San Francisco Jan. 26 and arriving at New York Feb. 12, via the Panama Canal route. For this trip the rates per person would vary, depending upon accommodations, from $350 to $500. In addition there would be the rail transportation and traveling costs to port of embarkation and return home from New York City.

Discussion of the plan occupied considerable time at two sessions. At the first session a committee was appointed to consider the proposal and report later during the convention. This committee brought in a majority report favoring the plan and a one-member (R. C. Marshall) minority report against it. A vote to reconsider the previous action of the executive board, which had named Chicago, was followed by active discussion of the majority and minority reports of the special committee. Proponents of the on-shipboard meeting urged its attraction as an educational holiday and the opportunity it provided to hold business and technical sessions of adequate length to think through the association's problems and decide on procedure. The opponents urged the objections of considerable cost and a long

Continued on p. 792

Bell Telephone Laboratory Head to Address A.S.T.M.

The American Society for Testing Materials will hear Dr. Frank B. Jewett, president of the Bell Telephone Laboratories, as third Edgar Marburg lecturer at the annual meeting of the society in Atlantic City, June 25-29. Dr. Jewett's subject will be "Some Research Problems Involved in Transoceanic Telephony." At the same session the second award of the Charles B. Dudley medal will be made to A. V. de Forest, research engineer of the American Chain Company, for his paper entitled "A Method of Graphic Representation of Magnetic Characteristics." The provisional program of the society promises a large number of papers and reports of outstanding interest.

President Signs the Flood Bill

CHANGES made in the flood-control bill proved satisfactory to President Coolidge and he signed the measure on May 15. The cost under the bill, $325,000,000 or more, will be borne by the federal government. An initial appropriation of $25,000,000 will be made immediately if the Chief of Engineers' recommendation is followed. Another preliminary step will be the selection of a civil engineer, who, with the Chief of Engineers and the president of the Mississippi River Commission, will form the board to consider the differences between the Chief of Engineers' plan and the plan of the M.R.C. and to make recommendations to the President. The finally approved project will be carried out by the M.R.C. While the cost is largely borne by the federal government, the local communities must contribute the cost of tributary levees and furnish rights-of-way on the main river. The final changes made in the bill were outlined in our "Washington Notes" column, May 10, 1928, p. 758.

Technical Problems Hold Attention of Fire Protection Body

Buildings, Garage, Private Fire Supplies and Fire Severity Are Discussed

THE 32d annual meeting of the National Fire Protection Association held in Atlantic City, May 7 to 10, was characterized by an unusually intensive attention to technical problems on the part of the 500 in attendance. Seventeen committee reports were the subject of official action, and some 40 others of an informative character were presented.

Among the items of especial interest to the civil engineering field were the reports of the committees on building construction, field practice, flammable liquids, garages, private fire supplies from public mains, and tanks.

S. H. Ingberg gave a detailed account of the fire-resistance studies of the Bureau of Standards. Fire test work of the bureau is expected to evaluate the probable severity and duration of fire in occupancies with known amounts of combustible contents. When this research is completed it should be possible, given the weight per square foot of combustible contents in any given area under consideration, to make a reasonably approximate prediction of the probable maximum fire severity, and proportion fire resistance of buildings and equipment on an engineering basis.

Detailed specifications for the construction of standard industrial buildings of concrete, timber and protected steel types were adopted in the report of the committee on building construction. Revised regulations on standpipe and hose systems for the protection of buildings of all classes were adopted; particular emphasis is laid upon standpipe protection for high buildings and for the maintenance of such protection in buildings under construction. The report of the committee on flammable liquids included new regulations for the construction of rooms, cabinets and outside houses for the storage of flammable liquids; recommended good practice for fire prevention and protection in marine oil terminals; and revised the regulations for both industrial and domestic oil-burning equipment.

Bus garages were the subject of a report which was tentatively adopted. This subject is of particular interest to both underwriters and transportation interests because of the very large values subject to destruction by a single

garage fire and the serious impairment to transportation facilities which might result from such a fire. The report calls for a superior grade of construction, limits areas, provides for sprinkler protection in all garages over two stories in height, and gives rules for the safeguarding of various fire hazards. Operating requirements require door openings of a much larger size than can be protected by standard fire doors such as heretofore have been in use.

The report of the committee on private fire supplies from public mains, also tentatively adopted, was devoted particularly to cross-connections. It places the association on record as in full sympathy with efforts being made to maintain the purity of public water supplies, but indicates that no fixed rules should be adopted for all situations and that double special check valves or other equally effective devices properly supervised should be allowed for fire services where conditions justify their use.

Allen M. Schoen, of Atlanta, was elected president of the association for the coming year.

Chicago Gives Up Fight Against Water-Meters

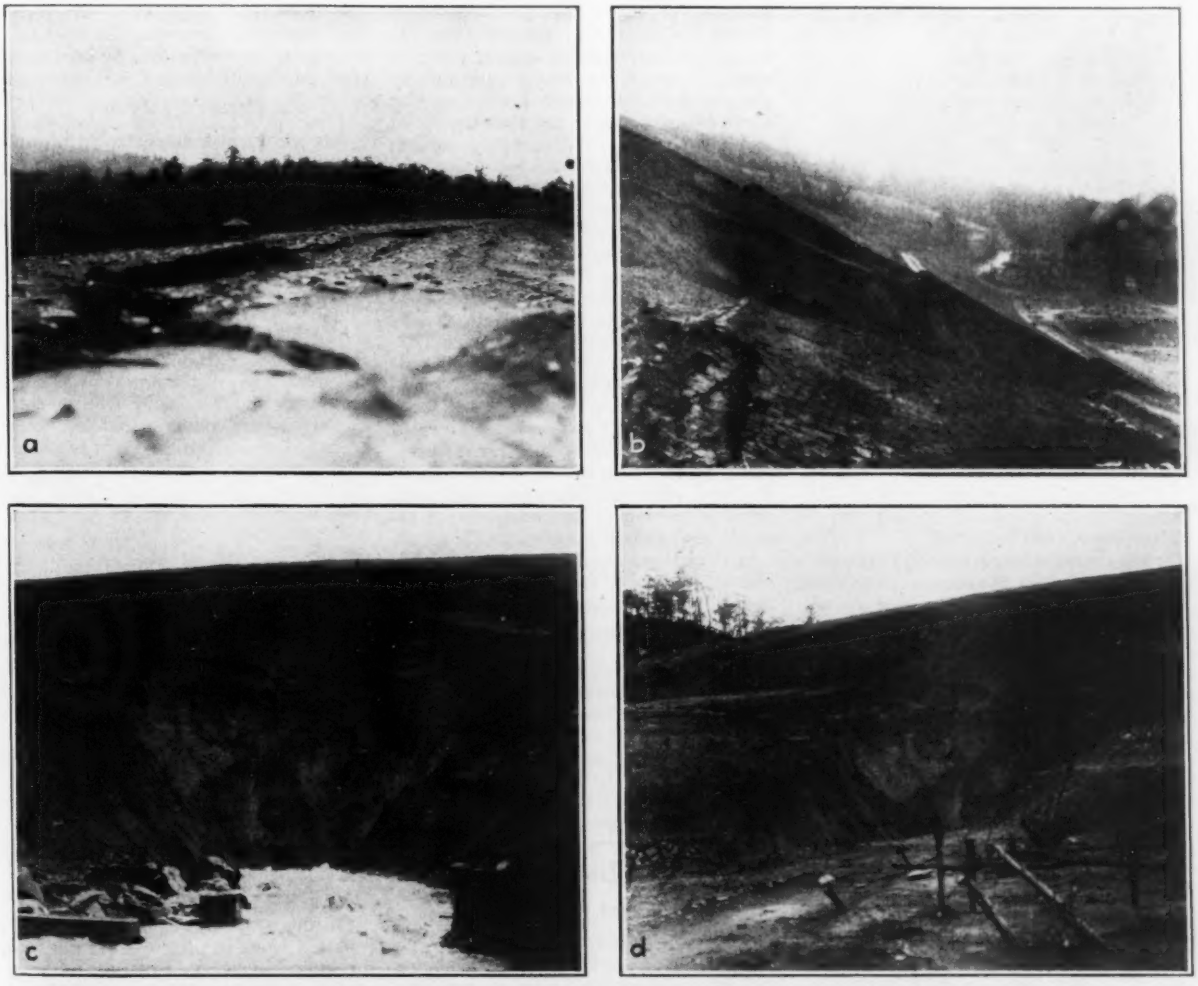
The Chicago City Council on May 14, passed an order providing for carrying out by 1935 of the general terms of the War Department order to meter 90 per cent of the water supply as a condition to the latest permit to divert water from Lake Michigan through the Chicago Drainage Canal. By an understanding between the city and the War Department single- and two-family houses need not be metered. The council, on the same day, appropriated $760,000 for the expenses of a bureau of water leak control.

High Buildings in Washington Meeting Opposition

The zoning commission of Washington, D. C., is considering a regulation limiting to 130 ft. the extreme height of buildings to be erected in the future. This was proposed by the National Capital Park and Planning Commission, and is being opposed by local builders. The present limit for building heights is 130 ft., but pent houses, spires, domes, towers, minarets, smokestacks, shafts and tanks are permitted to extend above the limit. The new regulation, if it is adopted, will bring these appurtenances below the line.

Opposition to tall buildings is based on two arguments: That congestion will be increased by the use of skyscrapers and that the dome of the Capitol should be the dominant architectural feature of the city.

SLIDES IN WATER SUPPLY DAM FOR GREENVILLE, S. C.



These views supplement the information given last week, p. 750, concerning the slides in the 140-ft. earth dam of the Greenville (S. C.) water-supply system

View *a* looks north along the crest of the dam and shows the cracking and settlement in the flat crest, just over the head of the slide; the reservoir is at the left, and the slide of the downstream face is just to the right of the picture. View *c* looks directly into the washout gorge. The concrete footwall and valve chamber of the 42-in. drain pipe are at the lower left.

View *b* also looks north, but on the downstream slope. Slide material is in the foreground, its displacement being indicated by the shift of the upper berm (at left) and of the middle berm (at middle of background and right edge of foreground). View *d* looks across the gorge (in the middle foreground) to the main part of the slumped area, and reveals the flat slope of the slide material.

Chamber of Commerce Extends Its Activities Into Engineering Fields

Trade Associations Take Part in Organization—Unsound Methods Denounced

IN ITS sixteenth annual meeting at Washington last week, the U. S. Chamber of Commerce brought together a stronger and larger gathering of American industrial and business leaders than at any time in its history. Important developments marked the meeting. Most significant perhaps was the entrance of trade associations into the work of the Chamber in an important way, which was further emphasized by a meeting of trade association executives at which Herbert Hoover, Secretary of Commerce, signalized the transformation of the trade association from an instrument intended to circumvent the anti-trust laws to a constructive force in the regulation of industry. Of corresponding importance were denunciation of business outlawry by Judge Edwin B. Parker, and a call for reform of business methods by Edward J. Mehren.

Resolutions adopted by the Chamber included the following: favoring the encouragement of shipbuilding and the permanency of private operation; favoring national preparedness by educational orders for munitions and equipment to private manufacturers in peace times; advocating additional appropriations for mining research; and asserting the responsibility of business to purge itself of dishonesty and unworthy practices.

William Butterworth, of Deere & Company, Moline, Ill., was elected president of the Chamber for the coming year.

Trade association matters were discussed in a session at which W. E. Humphrey, chairman of the Federal Trade Commission, reviewed that body's recent work. In the present practice of the commission, trade practice conferences are held, through which an industry meeting under the sponsorship of the commission is encouraged to set up its own code of ethics and of business practice; many bad practices have been eliminated from industry by this procedure.

Unsound Business Methods Denounced

Judge Edwin B. Parker, retiring chairman of the Chamber's Board of Directors, called on organized business to cast out those who by ruthless acts bring discredit upon business as a whole, and called upon corporation stockholders to repudiate those who misrepresent them by corruption. He spoke of "disturbing evidences of business atavism, a throwback to the day of the-public-be-damned." Business must, in order to maintain its professional status, scrupulously discharge its great responsibilities, among them to purge itself of pirates. In a later passage, he demanded that business in teamwork with labor find a remedy for irregularity in employment, and that by self regulation it shall eliminate waste and unfair trade practices.

Edward J. Mehren, vice-president of the McGraw-Hill Publishing Co., declared that at the root of present business difficulties lies the craze for volume. "We would sooner have volume than profit." His concrete suggestions were that every seller should determine not to alter a bid once submitted, and that sellers should insist on seeing all submitted prices when price concessions are demanded.

Transportation Development

Discussing group management, R. F. Pack, general manager of the Northern States Power Co., declared that it furnishes the highest type of management, the best available specialist brains, and auditing and rate-making ability, and that it brings about large economies in purchase and in financing. W. A. Draper, president of the Cincinnati Street Railways Co., speaking on city transportation, pointed out that 10,000 motor coaches are being operated by electric railway companies in regular service, and brought out that the street railway business is thoroughly modern in its tendencies and efforts, though by some persons considered to be archaic or obsolete. Samuel Dunn, editor of *Railway Age*, criticised present tendencies in railway regulation, and deplored the fact that the Interstate Commerce Commission has not adjusted rates as to enable railways to earn the allowed 5¾ per cent. We cannot long have adequate service, he said, unless the railways are both efficiently managed and fairly regulated.

Transportation problems were also discussed by Fred W. Sargent, president of the Chicago & Northwestern Railway, who said that one of the great needs is a friendly and co-operative attitude of the great mass of people to the transportation system, and a corresponding attitude of railway management toward the public served.

Latin-American Highways

Over the protest of the American Institute of Consulting Engineers, the transportation group of the chamber by a narrow majority voted to endorse legislation providing for detail of engineers from the U. S. Bureau of Public Roads to assist Latin-American countries in highway matters.

A.G.C. Board Meets

Continued from p. 790

period of isolation from business as likely to be a deterrent to attendance and general representation of membership at the convention.

Debate was closed by a resolution ordering the president and general manager to canvass the membership and if enough members were found who would commit themselves to take the sea trip to assure success for the convention to arrange for the on-shipboard meeting. Otherwise the convention was ordered to be held Chicago.

Relations With Sub-Contractors

Following a series of conferences with prominent sub-contractors a committee known as the allied construction industries committee, with George B. Walbridge as chairman, was created to include members of the executive board and two representatives of each of the following trade organizations: United Roofing Contractors of America, National Association of Sheet Metal Contractors, Elevator Manufacturers Association, Heating and Piping Contractors National Association, International Association of Master Painters and Decorators of America, National Association of Building Trades Employers, Association of Electragists, National Association of Master Plumbers, International Cut Stone Contractors and Quarrymen's Association, National Association of Marble Dealers, Contracting Plasterers International Association, and Tile and Metal Contractors Association of America. The first meeting of the committee will be held at Detroit, Mich., in June.

Credit Practices

Reporting on the movement begun to secure the co-operation of materials producers and equipment manufacturers in establishing sound credit practices, S. M. Williams, manager, Engineering Construction Division, A.G.C., announced wide response from individual firms. Resolutions were passed authorizing continuation of the work as follows: *"Resolved* That endeavor be made through conference and co-operation with manufacturers and distributors to establish reasonable and standard credit policies in all parts of the country; that contractors be urged to submit to such reasonable credit policies; that in purchasing, the A.G.C. members shall favor those manufacturers and distributors who accept and maintain such standard credit policies."

Following a request by Henry M. Baker, national director of emergency relief, American Red Cross, for action to insure co-operation in case of disaster, a committee was appointed to consider proper procedure. The committee reported advising that action be taken by all chapters to provide a stand-by organization for work in case of disaster, with relief and restoration agencies in all matters of preparing fair estimates of cost, selecting reliable contractors and preventing extortion in prices and wages.

Committee Reports

Of the standing committees, several reported work in progress but not ready for announcement. Finances were reported to be improving and if the improvement kept up substantial payments on the association's bonded debt would be possible. The committee on standard contracts announced the draft of a standard sub-contract which would follow through the usual course for consideration.

Road Builders Meet in Washington

The American Road Builders Association, at its annual meeting in Washington on May 11, elected Keith Compton, director of public works of Richmond, Va., as its president for the ensuing year. D. B. Dimick, of Birmingham, was installed as the new vice-president for the Southern district. The other new officers installed are S. M. Williams, of Washington, D. C., and W. R. Neel, of Atlanta, both of whom were elected directors.

At the meeting it was decided to accept the petition from city highway officials that they be incorporated as a division of the association. Accordingly Charles Upham, the director of the association, was authorized to call an organization meeting for the city officials on June 8. On this date officers will be elected and a constitution adopted. The primary object in bringing in this new division, according to Mr. Upham, is to standardize methods of handling traffic and to establish standards in street repair work. Another new division in the process of formation is one comprising road building officials, engineers and contractors of the Latin American countries.

City Planners Hold Conference

The twentieth annual meeting of the National Conference on City Planning was held in Texas, May 7 to 10. The first session, on May 7, was in Fort Worth; following that the entire attendance moved to Dallas for the remainder of the conference. At the final session, May 10, Edward M. Bassett, of New York, Harland Bartholomew, of St. Louis, and Flavel Shurtleff, also of New York, were re-elected as president, vice-president and secretary respectively. The following were chosen directors: G. B. Dealey, Dallas; Charles H. Cheney, Palos Verde, Calif.; George S. Buck, Buffalo; Edward A. Schilling, Detroit; John Ihlder, Washington; and Robert H. Whitten, New York. The selection of a meeting place for the next conference was put in the hands of the board of directors.

The American City Planning Institute, an affiliated body of technical experts, met during the conference and elected seven new members to the board of governors. They are: Andrew W. Crawford, director of the Philadelphia Park Association; Harold M. Lewis, executive engineer of the Regional Plan of New York; A. C. Godward, planning engineer for the Minneapolis City Plan Commission; Arthur C. Comey, member, Boston City Plan; E. P. Goodrich, consulting engineer, New York City; Herbert S. Hare, consulting engineer, Kansas City; and Harland Bartholomew, city planner, St. Louis.

The main conference, by resolution, placed its approval on the plan of budgeting capital improvements by bond issues, as recently done in Dallas. During the sessions particular attention was devoted to the subjects of traffic congestion and its causes, zoning regulations and the education of public sentiment to the many advantages of proper planning for the future.

Progress on Activated-Sludge Project for New York City

A report by George W. Fuller, consulting engineer, New York City, on various questions relating to the proposed activated-sludge plant for a part of New York City was laid before the Board of Estimate and Apportionment on May 10 by Arthur S. Tuttle, chief engineer of the board, and referred by the board to its special committee on the subject, consisting of Mr. Tuttle, the city comptroller and the borough president of Manhattan, with instructions to expedite the preparation of plans.

Mr. Fuller believes that the proposed Ward's Island site is large enough for a 240-m.g.d. activated-sludge plant, and that the initial plant should have a capacity of at least 180 m.g.d. For preliminary treatment either fine screens or settling tanks would be serviceable. For aeration compressed air rather than mechanical agitation is advised. Excess sludge should be pumped to a site near Rockaway Inlet, on Long Island, for either disposal at sea or for conversion into fertilizer. Encouragement is given to the idea that the sludge from this and other sewage-works of New York City could be made into a marketable fertilizer. Mr. Fuller advises construction of a 50-ton fertilizer plant for trial. He approves as adequate an estimate of $12,500,000, made by the engineering committee, for the cost of intercepting sewers in Bronx and Manhattan boroughs, tunnels to Ward's Island, and grit chambers, tide gates and regulators there. The cost of the proposed treatment plant, including a 50-ton fertilizer works and arrangements to ship sludge to sea, is put at $18,500,000.

Great Northern Railway Opens New Branch Line in Oregon

Service began on a new railroad route in southern Oregon May 12, when the Great Northern Railway branch line between Bend and Klamath Falls, Ore., was officially opened. The distance from Klamath Falls to Bend is 150 miles, of which about half is over Southern Pacific tracks and half is road newly built by the Great Northern and a reconstructed logging railroad. Prominent in the elaborate ceremonies were Governor Patterson of Oregon and Ralph Budd, president of the Great Northern. The new road will open a direct eastern outlet from southern Oregon territory near Klamath Falls.

Negotiations between the railroad companies on the one hand and the state government on the other looking toward the establishment of this new route have been in progress for several years. The most recent order of the Interstate Commerce Commission, the one authorizing this new route, was noted in our issue of May 10. p. 737.

Washington Notes

Flood-Control Bill Is Signed by President Coolidge—Boulder Dam To Come Up in House This Week

By Paul Wooton
Washington Correspondent

PRESIDENT Coolidge signed the bill providing for flood control on the Mississippi River shortly after noon on Tuesday, May 15, as announced elsewhere in this issue. Plans are now being made by some of the legislators from the valley to appear before the Director of the Budget to urge that $30,000,000 be approved as the amount that can be expended to advantage durthe coming year.

It is contended that work can be done on the side levees of the Bonnet Carré spillway within 30 days after the money is available. While the spillway itself has not been designed, much of the work can go forward in the meantime. Mapping work can start at once and plenty of dredging equipment is available. Strengthening and enlarging the main river levees, as well as those on the south bank of Red River and of the Arkansas River, can be speeded up and at least $5,000,000 should be made available for revetment, it is argued.

Great interest is now centering on the selection of the civilian member of the planning board. It is believed that the President will make this appointment in the near future so as not to delay a decision in the controverted portions of the two engineering reports, among which are the diversions through the Boeuf and Tensas basins and through the Atchafalaya Valley. It is expected that the President will make every effort to obtain the services in this connection of a very outstanding civil engineer.

Boulder Dam Prospects

A preferential legislative status was granted by the rules committee of the House of Representatives on May 15 to the Boulder dam bill. As this is written, the date for the consideration of the measure has not been arranged, but it is expected to come before the House during the current week. There is increasing interest in the bills proposing the creation of engineering boards to make further studies in connection with that project. The advocates of the dam appear to favor a board on which there will be only one engineer from the army, if they are forced to accept any commission.

New 70-Mile Railroad Authorized

The Mound City & Eastern Railway Company has been authorized by the Interstate Commerce Commission to construct 70 miles of new line between Mound City and McPherson, S. D. This work is to be completed before Dec. 31, 1928 at an estimated cost of $997,340.

Brief News

A BOND ISSUE totaling $7,248,000 was passed by the voters of Pittsburgh, Pa., by a majority of approximately 3 to 1 in the recent election. The city council states that "no time will be lost in the preparation of contract plans for the hundreds of improvements contemplated."

COMPLETION OF THE TWO Arthur Kill bridges between New Jersey and Staten Island will be celebrated on June 20. Both bridges will be in use more than six months earlier than had been promised and will be built at a total cost considerably less than the estimates.

THE 4.1-MILE IRRIGATION TUNNEL of the Nevada Irrigation District connecting the waters of the Middle Yuba River with the South Yuba has been successfully holed through. The tunnel is 9x9 ft. in section and 21,652 ft. long. The cost is placed at approximately $1,500,000.

MUCH ROAD WORK in Mobile County, Alabama, has been made possible through the approval of a bond issue of $5,000,000. This fund, together with state and federal aid, makes possible the immediate construction of 193 miles of paved highways, together with the necessary bridges and other structures.

THE BESSEMER GOLD MEDAL of the British Iron and Steel Institute was presented to Charles M. Schwab, chairman, Bethlehem Steel Corporation, in London on May 3. The conditions under which the medal is awarded were drawn up by Sir Henry Bessemer, and the medal was first presented in 1874. Mr. Schwab is the seventh American to receive the medal. The other Americans were Peter Cooper, Abram S. Hewitt, Andrew Carnegie, Alexander L. Holley, who introduced the bessemer process into this country; Henry M. Howe, the metallurgist, and John Fritz.

THE HIGHWAY BRIDGE over the Cooper River at Charleston is assured of an early start, according to H. M. Byllesby & Company, financiers of the project. The four chief contracts for construction work have been awarded to the following: The Foundation Company, substructure for the heavy spans; Charles E. Hillyer, Jacksonville, Fla., substructure for the approaches; McClintic-Marshall Company, Pittsburgh, for the main superstructure, and Virginia Bridge & Iron Company, Roanoke, Va., for the approach superstructure. The final cost of the bridge is placed at $5,750,000, while the four contracts so far let total $3,701,000. It is expected that the 2¾-mile structure will be completed in seventeen months. Waddell & Hardesty, New York, are the engineers.

New Station for Oklahoma City Approved by I.C.C.

The erection of a new station in Oklahoma City by the Chicago, Rock Island & Pacific Railway, to be used jointly by the St. Louis-San Francisco Railway, has been approved by the Interstate Commerce Commission. The project involves the abandonment of 0.77 mile of the present track and the construction of new line totaling 7.16 miles. The total cost of the improvement will be about $5,000,000, of which the city will bear a part.

Col. Kutz Transferred to Hawaii

Col. C. W. Kutz, for the past three years a member of the Mississippi River Commission and since 1921 head of the Central Division, U. S. Engineers, with headquarters at Cincinnati, Ohio, has been transferred to active military service at Honolulu, Hawaii.

During his service in Cincinnati, Colonel Kutz was in charge of U. S. Engineer activities over the entire Ohio River and its tributaries. He has seen many changes take place in this stream, for during the last five years approximately $7,000,000 per year has been expended for locks and dams for river regulation.

Break of 48-In. Water Main Quickly Repaired

Quick repair of a broken 48-in. force main at Garland and Sterritt Aves., Detroit, Mich. (noted in *Engineering News-Record* of May 3, 1928, p. 712), was made by the city department of water supply. F. N. Stephenson, engineer of the water system, is authority for the following facts:

"Notice of the break reached the department at 6:05 a.m. April 25. At 6:15 a.m. the high service pump was shut down. At 7:20 a.m. the break had been isolated, and pumping was resumed at 7:25 a.m. Pressures were gradually built up and were normal in the district shortly after 10 a.m. Repairs were made and service resumed through the main affected at 2 a.m., April 26."

Award Champlain Bridge Contract

Bids for the construction of the proposed new bridge across Lake Champlain between New York and Vermont were opened on May 8 at Ticonderoga, N. Y. Contractors were invited to bid on either the substructure or the superstructure, or both, and could use either open or pneumatic caissons for the piers. Only one bid was received for the complete project, that of James E. Cashman, Inc., of Burlington, Vt., for $1,055,930. Eight firms submitted bids for the substructure alone, and five for the superstructure. Final awards were made to the low bidders: Merritt-Chapman & Scott Corporation, substructure by open cofferdam method, $385,000; American Bridge Company, superstructure, $535,177.05.

Railroad Awards to Be Made by Safety Council

On May 21, 1928, the National Safety Council will make awards to seven railroads that have maintained the highest safety records in their respective classes during 1927. The awards will be made at a dinner held at the Chicago Athletic Association. The classes are divided in accordance with the number of man-hours of work performed during the year in rail operations only, without reference to water transportation auxiliary services. The roads to be honored this year are: Union Pacific System (over 100,000,000 man-hours); Union Pacific Railroad Company (50,000,000 to 100,000,000 man-hours); Oregon Short Line Railroad Company (10,000,000 to 50,000,000 man-hours); Los Angeles & Salt Lake Railroad Company (10,000,000 to 20,000,000 man-hours); Duluth, Missabe & Northern Railway Company (5,000,000 to 10,000,000 man-hours); Duluth & Iron Range Railroad Company (2,000,000 to 5,000,000 man-hours); and the Baltimore, Chesapeake & Atlantic Railway Company (less than 2,000,000 man-hours).

Convention to Unite Ports of Pacific and Far East

At last year's convention of the Pacific Coast Association of Port Authorities, with the purpose of promoting a closer association with port authorities on the other side of the Pacific, the name of the organization was changed to "Association of Pacific and Far East Ports." To stimulate interest in the association among ports of the Far East, it is planned to hold conventions in some of those ports in future years. The 1928 convention, however, will be held in Los Angeles on June 27, 28 and 29, and in San Diego on June 30.

George F. Nicholson, harbor engineer, Los Angeles, Calif., is secretary-treasurer of the Association of Pacific and Far East Ports.

Rail and Track Inspection System Organized

Announcement of the completion of a car fitted with the Sperry electric devices for detecting transverse fissures in rails in tracks was made at the recent convention of the American Railway Engineering Association, and the Sperry Rail Service Corporation has now been organized to provide for the operation of this car on railways for testing rails in track and both indicating and recording the presence of such interior defects as transverse fissures. The company's service will also include the use of equipment for recording the physical condition of the track as to line, surface, rail joints and other features. The president is Elmer A. Sperry, Manhattan Bridge Plaza, Brooklyn, N. Y.; vice-president in charge of operation, Charles W. Gennet, Jr., Railway Exchange Building, Chicago.

Engineering Societies

Calendar

Annual Meetings

AMERICAN ASSOCIATION OF ENGINEERS, Chicago; Annual Convention, El Paso, Tex., June 4, 5 and 6.

AMERICAN WATER WORKS ASSOCIATION, New York; Annual Convention, San Francisco, week of June 11.

SOCIETY FOR THE PROMOTION OF ENGINEERING EDUCATION; Annual Meeting, University of North Carolina, June 25.

AMERICAN INSTITUTE OF QUANTITY SURVEYORS, Chicago; Annual Convention, New York, June 25-27.

AMERICAN SOCIETY FOR TESTING MATERIALS, Philadelphia; Annual Meeting, Atlantic City, June 25-29.

AMERICAN SOCIETY OF CIVIL ENGINEERS; Annual Convention, Buffalo, N. Y., July 18-20.

DETROIT ENGINEERING SOCIETY has elected offices for the year 1928-29 as follows: President, Charles J. Peck; first vice-president, J. P. Hallihan; second vice-president, E. M. Walker; past-president, William F. Zabriskie; secretary-treasurer, F. A. Kimmich.

THE BALTIMORE SECTION, American Society of Civil Engineers, at a meeting held May 10, elected C. E. Keeter president and S. L. Thomsen vice-president. A committee was appointed to prepare a revision of the constitution.

Personal Notes

EUGENE W. STERN, consulting civil engineer, of New York City, has been elected a vice-president of the Colonial Iron Works Company, of Cleveland, Ohio. He will act in an advisory capacity and assist in directing the general policy of the company. Mr. Stern was at one time chief engineer of highways, Borough of Manhattan, and served throughout the war as Major of Engineers.

EDWARD M. TURNER, engineer of construction for the west Tennessee division of highways, has been promoted to division engineer, succeeding L. C. McEwen, who was promoted to chief engineer of the Tennessee Highway Department.

W. N. REES, senior resident engineer, Tennessee Highway Department, has been promoted to be engineer of construction for the west Tennessee division, succeeding Edward M. Turner, promoted to division engineer.

Prof. HERBERT C. SADLER, head of the department of marine engineering, University of Michigan, and a member of the faculty since 1901, was named dean of the colleges of engineering and architecture by the board of regents on April 24. Professor Sadler succeeds Prof. Mortimer E. Cooley, who resigned a year ago but whose resignation does not take effect until July 1.

W. G. KOVY, senior resident engineer, has been appointed assistant engineer of construction in the west Tennessee division of highways.

COVINGTON K. ALLEN, who has been engineering assistant to Frank W. Jacoby, commissioner of street cleaning, Baltimore, has been appointed engineer in charge of the reservoir under construction at Towson, Md. He will work under the direction of the Public Improvement Commission, Baltimore. The appointment has been approved by the Board of Estimates.

S. H. FRAME, who has been for some years with the department of natural resources, Canadian Pacific Railway, as assistant engineer on its irrigation block in Alberta, has received an appointment with the British Columbia government in the water rights branch of the Department of Lands to investigate as field engineer the power possibilities of a large area in the center of the province.

MARK B. OWEN, formerly assistant city engineer, has been appointed commissioner of the department of public works of Fordson, Mich. This department is a consolidation of the former department of public works and the engineering department.

Capt. ROBERT D. INGALLS, of the Second Engineers, U.S.A., stationed at Fort Logan, Colorado, left on May 1 for Duluth, where he will be assistant to the division engineer in charge of harbor and waterway improvements.

J. M. FOURMY, of Hammond, La., has been appointed engineer for the state highway commission of Louisiana, a position he has held twice before under previous administrations.

L. J. SVERDRUP, assistant to the chief engineer of the Missouri state highway department, in charge of the bureau of bridges, has resigned and has been succeeded by N. R. SACK, previously division engineer for the department at St. Joseph.

WALTER R. JEFFREY, formerly with the U. S. Army Engineers, the Sinclair Refining Company and the Insull group of public utilities, has opened an office in the Monadnock Building, Chicago. He will specialize in tabulating work for engineers and statisticians.

WARREN RAEDER, who has been serving as an instructor of civil engineering at the University of Colorado, Boulder, was advanced to an assistant professorship on April 23.

HAROLD R. DEAN, consulting engineer, 234 Main St., Poughkeepsie, has been retained by the city planning commission of Poughkeepsie as consulting engineer.

Obituary

HENRY J. CAMBIE, one of Canada's pioneer engineers on railroad construction and location, died in Vancouver, B. C., on April 23 at the age of 91. He was born in Tipperary, Ireland, in 1837 and came to Canada when he was fifteen years old. Immediately thereafter he entered the office of Walter Shanley, who was then directing the engineering work on the Toronto & Guelph Railway, afterward absorbed by the Grand Trunk. He had therefore been engaged in railroad construction work for nearly 76 years at the time of his death. When the Canadian Pacific was being built Mr. Cambie was given charge of the reconnoissance and preliminary surveys in British Columbia and convinced the authorities at Ottawa of the suitability of Vancouver as a terminal port. He found a feasible route for the railroad through the Fraser River canyon and directed the location and construction of the road along that route. In 1886 Mr. Cambie was appointed division engineer of the Pacific division of the Canadian Pacific and became special assistant engineer in 1902. In recent years he had been serving the railroad as consulting engineer.

EDWARD F. MURPHY, formerly commissioner of public works of the city of Boston, died suddenly on April 23 after an illness of five days. He had been in the city's employ during most of his adult life, with intervals during which he was associated with the New England Telephone & Telegraph Company in charge of underground conduits throughout Massachusetts and with the Hugh J. Riley Construction Company, as consulting engineer on a $3,000,000 contract for a sewer and water system in Cuba. He was 57 years old.

WILLIAM L. MILLER, engineer and contractor in Boston and Charlestown, Mass., died on April 25. During his 45 years of business life he handled many large contracts on the Boston waterfront and along the coast from Nova Scotia to Cuba.

WILLIAM E. GELSTON, consulting engineer of the Pittsburgh city bureau of engineering and one of the oldest employees of the city in point of service, died on April 25. He was 74 years old and had been in the city service for more than 54 years, working up from chainman to consulting engineer.

CHARLES GORDON JAMES, assistant city engineer of Pueblo, Colo., and connected with the engineer's office for the last twenty years, was found dead at the wheel of his automobile on April 21. He was 53 years old.

HUBERT SHAW, division engineer for the Illinois State Highway Department, died at Cairo, Ill., on April 22. He had been with the department for several years.

Construction Equipment and Materials

A Section Devoted to What the Manufacturer Is Doing for the Engineer and Contractor

New England Holds Fourth Outdoor Equipment Show

Many Distributors Among the 75 Exhibitors Contributing to the Three-Day Show

The fourth annual construction equipment show was held near Boston, May 9, 10 and 11, under the auspices of the Massachusetts Highway Association. The show, which has been held annually as an outdoor demonstration near Cottage Farm Bridge, Cambridge, continues to grow. About 75 exhibitors contributed to the success of the 1928 exhibition, which was well attended in spite of the inclement weather. Those who attended during the three days were not required to register, so that no figures are available as to attendance.

The feature of the show was the fact that it was held outdoors and that most of the equipment, from the large power shovels to the smaller units, as pumps and compressors, was in operation.

There was no one exhibit that stood out above the others. Hedge & Mattheis, equipment distributors, Boston, had perhaps the largest exhibit, since it included the equipment of about since it included the equipment of about eighteen different manufacturers. The majority of equipment distributors showed practically a complete line of their products. There were several exhibits of equipment that is new or improved since the first of the year.

The New England Implement Company, Boston, exhibited a tractor-mounted bucket loader which was recently developed. The frame is electric welded throughout. The machine is powered with a Buda engine, is bronze bushed and Dot lubricated. The bucket loader includes a blade gatherer and is equipped with a swivel chute and an overload release.

The Highway Service Company, New Bedford, Mass., exhibited a new 1-ton highway sand spreader for attachment to motor trucks.

The Conant Machine & Steel Company, Concord Junction, Mass., exhibited a bucket loader with a hand-crowding and swinging device. The company also exhibited a belt loader, chain driven from a Le Roi engine.

Charles J. McCarthy & Company, equipment distributors, Boston, exhibited a new Lansing 1-bag portable mixer. This new mixer is equipped with an accurate water-measuring device and is manufactured with extra large drum openings to assist in rapid mixer output. This company also exhibited a new shovel of the Speeder Machinery Company, equipped with an 18-ft. boom, electric lights and starter.

The Rotary Snow Plow Company, Minneapolis, Minn., exhibited its new city-type, single-fan snow plow. This plow is so designed that it can be operated from the power take-off of any type of tractor. It has an adjustable snow chute so that the snow may be loaded into wagons or discharged at a distance from the machine.

The Sullivan Machinery Company, Chicago, exhibited its new K-3 concrete buster designed to strike a slow, heavy blow. It is claimed to have an extremely low air consumption so that two busters may be run from one 110-ft. portable compressor.

The Oulton Machine Corporation, Bellows Falls, Vt., exhibited a novel compressor. The machine is small and of light weight. It operates on a principle of "air momentum" rather than from air under pressure. The machine was shown attached to an air drill by two pieces of hose. The air expelled through one hose enters the top of the hammer, driving down the floating piston, while the air expelled through the other hose returns the floating piston to its original position.

Mead-Morrison, Boston, exhibited its ½-yd. gas shovel which has been improved in several details. The new machine weighs 38,000 lb. instead of 33,000 lb., has an 18-in. crawler tread instead of a 14-in. tread and uses a heavier boom than did the old machines.

Reed-Prentice Corporation, Worcester, Mass., exhibited its new air-motor-driven portable saw. This is powered by an Ingersoll-Rand air motor, and weighs 95 lb.

Concrete Road Yardage

There is given below a tabulation of concrete pavement yardage awarded during April, 1928, together with the total number of square yards awarded for the year to April 28, 1928, as prepared by the Portland Cement Association. The figures represent awards in the United States only:

	Square Yards Awarded During April, 1928	Square Yards Awarded From Jan. 1, 1928 to April 28, 1928
Roads	12,722,131	31,186,651
Streets	4,780,219	11,680,140
Alleys	285,154	727,793
Totals	17,787,504	43,594,584

Foundry Research at Mellon Institute

Announcement has been made by Dr. Edward R. Weidlein, director, Mellon Institute of Industrial Research, Pittsburgh, Pa., that the Whiting Corporation, Harvey, Ill., has established an industrial fellowship, whose holder, Dr. Edward E. Marbaker, will conduct research on cast iron. Dr. Marbaker will work in close co-operation with the research committee of the American Foundrymen's Association.

Separate Sludge Digestion Order From Europe by Telephone

An order has recently been received by the Dorr Company, New York City, by transatlantic telephone, which the company claims marks the introduction of the separate sludge digestion process in Europe. The order covers a large amount of equipment for a new municipal sewage treatment plant in Upper Silesia, Poland, and includes clarifiers and allied equipment.

The new plant was authorized by the Rawa-Verband, an organization similar in purpose to the boards of American sanitary districts. The order follows a lengthy engineering study into the unsanitary conditions prevailing in and along the banks of the Rawa Creek near Kattowitz. The unsanitary condition was caused by the discharge of untreated municipal sewage and trade wastes from a congested industrial section. Arrangements have been made to provide funds annually for the next few years for the construction of additional treatment plants so that this entire section may be improved for the benefit of the industries that are rapidly growing up along the banks of the creek.

Lumber Association Indorses Standards and Trade Marks

Standardization of lumber and careful control of production were advocated strongly by Wilson Compton, secretary and manager of the National Lumber Manufacturers Association, at the annual meeting of this association held recently at Chicago. In his annual report Mr. Compton said: "Standardization is necessary to enable the lumber industry to hold its markets in competition with highly standardized competing materials. But without intelligent control of production and the careful adaptation of supply to consumption much, if not most, of the potential advantages of standardization will have been forfeited, notwithstanding whatever else may be done or omitted. The dependable progress and prosperity of the lumber industry is not to be secured without it."

He called attention also to the necessity of standard lumber being adequately marked and guaranteed. As a result, a resolution was adopted declaring that the association will promote by national advertising and otherwise the trade and grade marks of all regional associations whose grading rules conform with American lumber standards, and will also license the use of a national trademark indicating dry lumber in accordance with the practice and control developed by each regional association. The use of the national trademark will be restricted to lumber which carries the regional grade and

trade marks and which is cut to American standard sizes and specifications.

Other reports dealt with the association's engineering activities, by Frank P. Crawford, chief engineer, and with research work and the promotion of building codes, by John M. Gibbs, manager of the trade extension bureau. Among the ten prizes awarded by the committee on utilization and waste prevention were $750 for a moisture-recording device for dry kilns and $50 for an automatic lumber-marking machine. Officers for 1928-29 include: President, E. L. Carpenter, Minneapolis, Minn.; vice-presidents, W. M. Ritter, Columbus, Ohio; R. E. Danaher, Detroit, Mich., and A. C. Dixon, Eugene, Ore.; secretary and manager (re-elected), Wilson Compton, Washington, D. C.

Business Notes

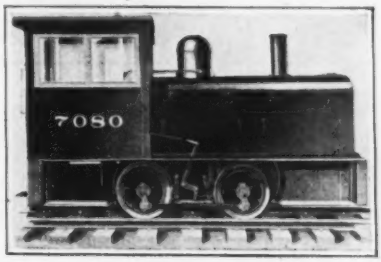
CELITE COMPANY, Los Angeles, announces its purchase of the plant and property of the National Magnesia Manufacturing Company, Redwood City, about 25 miles south of San Francisco. The business of the latter company will be continued under the name of the National Magnesia Company. The business will include the manufacture of magnesia, asbestos and diatomaceous earth insulating materials.

INTERNATIONAL CEMENT CORPORATION, New York City, announces the purchase of the Phoenix Portland Cement Company, Nazareth, Pa., and the Warrior Cement Corporation, Demopolis, Ala. These additions bring the company's plants to a total of thirteen, with a productive capacity of 20,000,000 bbl. The Nazareth plant will be operated by the Lone Star Cement Company, Pennsylvania, and the Warrior plant will be operated by the Alabama Portland Cement Company, both subsidiaries of the International Cement Corporation.

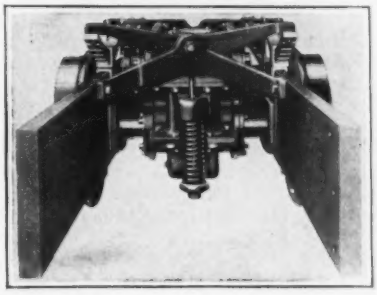
ALPHA PORTLAND CEMENT COMPANY, Easton, Pa., announces the purchase on May 1 of the property of the Phoenix Portland Cement Corporation, Birmingham, Ala., an acquisition which will increase the productive capacity of the Alpha company to 12,500,000 bbl. annually. The Phoenix plant was built in 1926 and started operations in March, 1927. It is so designed that an increase in capacity of 50 per cent can be readily and economically made. Lindley C. Morton, former president of the Phoenix Portland Cement Corporation, is retiring from the cement business to devote himself entirely to his personal interests. R. J. Hawn, vice-president, will also retire from the company. Aside from these no changes in the personnel connected with the Phoenix plant is contemplated.

Spring Suspended Power Unit for New Gasoline Locomotive

A gasoline locomotive new in design and drive principle has just been brought out by H. K. Porter Company, Pittsburgh, Pa. The power plant, clutch and transmission are mounted on a steel sub-frame and form a straight-line drive to the reverse unit. This sub-frame acts as a torque arm pivoted on the rear axle and spring suspended at the front from the main frame. By an ingenious arrangement the weight of the rear end of the sub-frame is carried on the main frame by a coil spring. The result is that all the vital parts of the locomotive—the engine, radiator, clutch, transmission and reverse unit—are mounted on a sub-frame which is spring suspended to a cross-equalized main frame. This is shown in the accompanying illustration. Patent is pending on this improvement.



The main frames and bumpers are made from rolled steel slabs. The running gear, including steel-tired driving



wheels, side rods, driving boxes, shoes, wedges, springs, etc., is the same as on the Porter steam dinky.

Manufacturers and Trade Associations

Calendar

Annual Meetings

AMERICAN WATERWORKS MANUFACTURERS ASSOCIATION, New York City; annual meeting, San Francisco, Calif., June 11-14.

New Publications

Compressed Air Data Book—INGERSOLL-RAND COMPANY, New York City, has published the sixth edition, revised, of its book entitled "100 and 1 Ways to Save Money." The booklet is a symposium of job operating data upon which the company's portable compressors have been used for operating various types of pneumatic tools. Considerable comparative cost data are included. A system of cross-indexing makes the 140-page book decidedly practical.

Bitumen Gun—QUIGLEY FURNACE SPECIALTIES COMPANY, 26 Cortlandt St., New York City, in bulletin 301 describes its new bitumen gun for shooting hot or cold coatings on metal, concrete, stone, brick, wood or other surfaces.

ROCK ASPHALT QUARRY OPERATIONS IN KENTUCKY

Aërial view showing parts of two of the quarries being worked by the Kentucky Rock Asphalt Company, Louisville, Ky. The complete operations cover four quarries with a combined quarry face of about 3,000 ft.

Business Side of Construction

Facts and Events That Affect Cost and Volume

Penn-Dixie and North American Cement Companies Unite

On May 23 stockholders of the North American Cement Corporation and the Pennsylvania-Dixie Cement Corporation will vote on an agreement of consolidation already signed by the directors. The new company, known as the General Cement Corporation, will have a capacity of 14,000,000 bbl. per year.

The Penn-Dixie mills are located at Richard City, Tenn.; Penn-Allen, Nazareth and Bath, Pa.; Portland Point, N. Y., and Clinchfield, Ga. The North American mills are at Howes Cave and Catskill, N. Y.; Security, Md., and Martinsburg, W. Va. The capacity of these mills amounts to 8 per cent of the total cement production in the United States in 1927.

There is some inclination in the cement trade to look for the consolidation of the General Cement Corporation with the International Cement Corporation. The latter has mills at North Birmingham, Ala.; Greencastle, Ind.; Bonner Springs, Kan.; New Orleans, La.; Hudson, N. Y.; Dallas and Houston, Tex.; Norfolk, Va.; Nazareth, Pa.; Demopolis, Ala; Marel, Cuba; Buenos Aires, Argentina, and Montevideo, Uruguay. Acquisition of the Nazareth and Demopolis mills was announced on May 2, 1928.

The annual capacity of the International Cement Corporation's mills is 20,000,000 bbl., or 12 per cent of the total cement production of the United States in 1927.

Cement production and shipments both increased during April, compared with March, 1928, but a decrease from April, 1927, totals was shown. Stocks on hand at the end of April were about 1 per cent larger than a month ago and about 16 per cent ahead of last year. There has been more cement produced in 1928 than during the first four months of last year and shipments during the same period have been lower in 1928.

This Week's Contracts

Heavy construction contracts, reported by *Engineering News-Record* in the week ended May 17, with some comparisons, total as follows:

(In Thousands of Dollars, 000 Omitted)

Week Ended	Public	Private	Total
May 17, 1928	**$43,466**	**$50,322**	**$93,788**
May 10, 1928	42,680	33,769	76,449
May 19, 1927	32,923	51,247	84,170
Jan. 1 to date:			
1928	481,625	844,016	1,325,641
1927	416,179	682,468	1,098,647

E. N.-R. Index Numbers

Cost			Volume		
May 1, 1928	**207.00**		**April, 1928**	**31g**
Apr. 1, 1928	206.40		March, 1928	31g
Apr. 1, 1927	206.80		April, 1927	257
Average, 1927	206.24		Average, 1927	263
Average, 1926	208.03		Average, 1926	22g
1913	100.00		1913	10g

Low Bid $2.56 Per Barrel on Cement for Wisconsin

Cement bids for the Wisconsin federal aid highway program in 1928, covering 474,961 bbl., to be distributed at delivery points in 53 counties, show the following ranges:

Bidder	—Price Per Bbl.— Including 40-Cent Bag Charge Low	High
Universal Portland Cement Co.	$2.56	$2.75
Western Lime & Cement Co.	2.56	2.78
Dewey Portland Cement Co.	2.56	2.78
Petoskey Portland Cement Co.	2.60	2.75
Marquette Cement M'f'g. Co.	2.60	2.76
Lehigh Portland Cement Co.	2.60	2.76
Sandusky Portland Cement Co.	2.60	2.76
Alpha Portland Cement Co.	2.60	2.76
Atlas Portland Cement Co.	2.60	2.76
Manitowoc Portland Cement Co.	2.60	2.79
Newaygo Portland Cement Co.	2.62	2.78
Cutler Magner Co.	2.63	2.76
N.W. States Portland Cement Co.	2.64	2.76

Business Notes

The Federal Reserve Board's index of business based on bank clearings was higher for the month of April, 1928, than a year ago, according to the preliminary estimate. The earlier months this year have been about the same as last year and the year to date showed business activity to be only slightly higher than 1927.

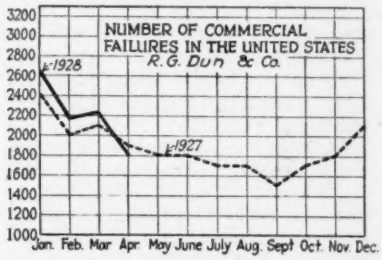
Brick shipments during March were greater than those in the preceding month and the same month last year. Orders on the books April 1, 1928, were about 9 per cent higher than on March 1, but were considerably lower than a year ago. Stocks of burned brick were smaller than a month and a year ago and unburned brick stocks on hand were only slightly larger.

Public utility earnings reported by the Department of Commerce for the first two months of 1928 were higher than last year. Net earnings for 95 companies, exclusive of telephone and telegraph companies, were $157,589,000, or 12 per cent greater than earnings a year ago. Gross earnings were only 5 per cent above January and February, 1927.

Steel ingot production in April, 1928, showed an increase in rate of production. The average daily output was 3 per cent above that of the preceding month and 9 per cent above production in April, 1927. The decrease in unfilled orders of the United States Steel Corporation was 463,073 tons, or 11 per cent below orders on the books at the end of March. Both 1927 and 1926 unfilled orders on April 30 were smaller than this year's figure. The steel industry was operating at 91.29 per cent capacity during April, which was a higher rate than in any month in 1928 or 1927. The first four months of this year have shown greater activity than last year.

Total freight loadings for four months of 1928 were 5 per cent lower than those of last year.

Business failures during April showed favorable declines both in number of defaults and in total liabilities. Total liabilities have been smaller in each month of 1928 than in the corresponding month of 1927, and to date 1928 has shown a 13 per cent decrease from reports for last year. Compared with liabilities in March, last month showed a 36 per cent decrease and was 34 per cent lower than April, 1927. The reduction in failures is usual at this season, but the number of failures in April, 1928, was smaller than that for any April since 1924 and the lowest figure for April liabilities reported since 1920. April was the first month in 1928



during which there was a smaller number of failures than in the corresponding month a year ago. This year to date shows an increase of 3 per cent over the number of defaults in 1927.

Earnings of Construction Corporations in 1927

There are twenty corporations dependent upon and directly related to the construction industry for which earnings statements for 1927 have been made public. Eight of these companies reported increased earnings per share of common stock in comparison with 1926 earnings. The average yield of these stocks, based on the dividend rate in the first quarter of 1928 and the market price on March 17, was 5.2 per cent. Twelve companies showed a decrease from 1926 earnings per share of common stock. The average yield of the stock of these companies was 4.4 per cent. Eight companies showed decreases and five increases in 1927 income before fixed charges. These corporations include asphalt, cement, equipment, supplies, materials, and construction companies. Total invested capital for the twenty here discussed is $522,468,000 and the total number of shares of common stock outstanding is 7,221,000.